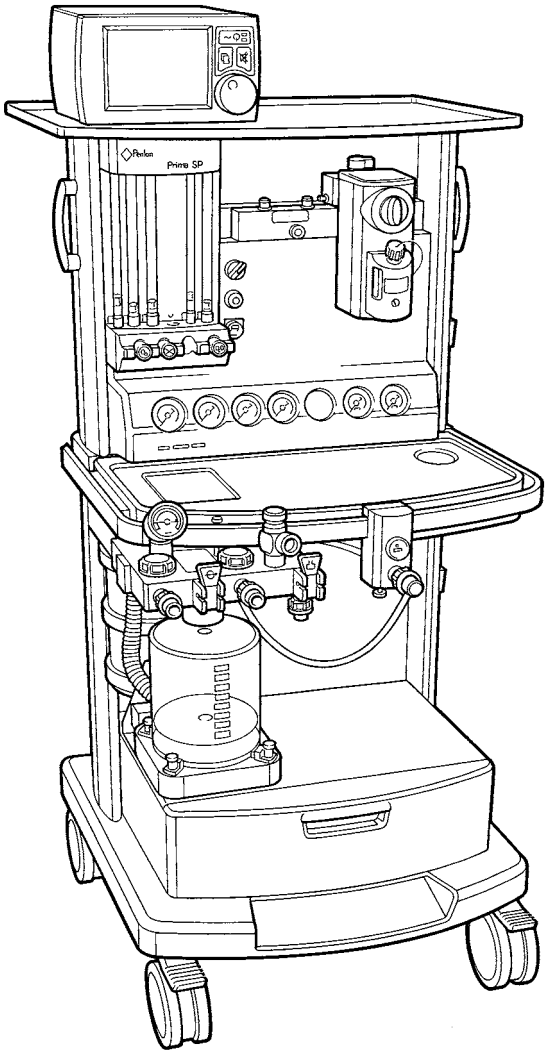
InterMed Penlon

Prima SP Anaesthetic Machine Range Service Manual



Quality and Assurance in Anaesthesia

THE IMPORTANCE OF PATIENT MONITORING

WARNING

Anaesthetic systems have the capability to deliver mixtures of gases and vapours to the patient which could cause injury or death unless controlled by a qualified anaesthetist.

There can be considerable variation in the effect of anaesthetic drugs on individual patients so that the setting and observation of control levels on the anaesthesia systems does not in itself ensure total patient safety.

Anaesthesia system monitors and patient monitors are very desirable aids for the anaesthetist but are not true clinical monitors as the condition of the patient is also dependent on his respiration and the functioning of his cardio-vascular system.

IT IS ESSENTIAL THAT THESE ELEMENTS ARE MONITORED FREQUENTLY AND REGULARLY AND THAT ANY OBSERVATIONS ARE GIVEN PRECEDENCE OVER MACHINE CONTROL PARAMETERS IN JUDGING THE STATE OF A CLINICAL PROCEDURE.

IMPORTANT

Servicing and Repairs

In order to ensure the full operational life of this anaesthetic machine, servicing by a Penlon-trained engineer should be undertaken periodically.

The machine must be serviced to the schedule detailed in section 8.
Details of these operations are given in this Service Manual, available only for Penlon trained engineers.

For any enquiry regarding the servicing or repair of this machine, contact the nearest accredited Penlon agent:

or communicate directly with:

Technical Support Department
Penlon Limited
Abingdon Science Park,
Barton Lane
Abingdon
OX14 3PH
UK

Tel: +44 (0) 1235 547076
Fax: +44 (0) 1235 547062
E-mail: technicalsupport@penlon.co.uk

Always give as much of the following information as possible:

1. Type of equipment
2. Product name
3. Serial number
4. Approximate date of purchase
5. Apparent fault

FOREWORD

This manual has been produced to provide authorised personnel with information on the function, routine performance, maintenance checks and repair procedures applicable to the Prima SP anaesthetic machine range.

Information contained in this manual is correct at the date of publication.
The policy of Penlon Limited is one of continued improvement to its products.
Because of this policy, Penlon Limited reserves the right to make any changes which may affect instructions in this manual, without giving prior notice.

Personnel must make themselves familiar with the contents of this manual and the machine's function before using the apparatus.

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USER RESPONSIBILITY

This anaesthetic machine has been built to conform with the specification and operating procedures stated in this manual and/or accompanying labels and notices when checked, assembled, operated, maintained and serviced in accordance with these instructions.

To ensure the safety of this device it must be checked and serviced to at least the minimum standards laid out in this manual. A defective, or suspected defective, product must not under any circumstances be used.

The user must accept responsibility for any malfunction which results from non-compliance with the servicing requirements detailed in this manual.

Additionally, the user must accept responsibility for any malfunction which may result from misuse of any kind or non-compliance with other requirements detailed in this manual.

Worn, broken, distorted, contaminated or missing components must be replaced immediately. Should such a repair become necessary it is recommended that a request for service advice be made to the nearest Penlon accredited agent.

This device and any of its constituent parts must be repaired only in accordance with written instructions issued by Penlon Limited and must not be altered or modified in any way without the written approval of Penlon Limited. The user of this equipment shall have the sole responsibility for any malfunction which results from improper use, maintenance, repair, damage or alteration by anyone other than Penlon or its appointed agents.

USA and Canadian Federal Law restricts the sale and use of this device to, or on the order of, a licensed practitioner.

Statements in this manual preceded by the following words are of special significance:

WARNING	***means there is a possibility of injury to yourself or others.***
CAUTION	*means there is a possibility of damage to the apparatus or other property.*
NOTE	*indicates points of particular interest for more efficient and convenient operation.*

Always take particular notice of the warnings, cautions and notes provided throughout this manual.

1. WARNINGS AND CAUTIONS

The following ***WARNINGS and CAUTIONS*** must be read and understood before using this anaesthetic apparatus.

WARNINGS

1. ***This apparatus is designed for use only with non flammable anaesthetic agents. It must not be used with or in close proximity to flammable anaesthetic agents, due to a possible fire or explosion hazard.***

2. ***Exterior panels must not be removed by unauthorised personnel and the apparatus must not be operated with such panels missing.***
   On machines with an electrical power supply, there is a possible electric shock hazard.

3. ***No oil, grease or other flammable lubricant or sealant must be used on any part of the machine in close proximity to medical gas distribution components.***
   There is a risk of fire or explosion.

   Unless otherwise stated, O-rings and other elastomeric seals must only be lubricated with an oxygen compatible lubricant. Use sparingly.

4. ***When attaching cylinders of medical gases ensure that the machine yoke and cylinder faces are dust free and clean and that the sealing washer provided is in position between the cylinder valve and the yoke.***
   Tighten the yoke securely before opening the cylinder valve. Dust and dirt presents a fire hazard in the presence of high pressure gas.
   Leakage of high pressure gas can cause serious injury.

5. ***Anaesthesia apparatus must be connected to an anaesthetic gas scavenging system (AGSS) to dispose of waste gas and prevent possible health hazards to operating room staff.***
   This requirement must be observed during test procedures as well as during use with a patient.

6. ***Prima SP machines must only be used with Sigma Delta vaporizers (or other vaporizers approved by Penlon Limited) installed by means of the Cagemount or Selectatec system.***
   Free-standing vaporizers may be accidentally tipped, resulting in excessive and uncalibrated volumes of anaesthetic drug entering the breathing system

   Do not install or connect any vaporizers of any description between the Common Gas Outlet (CGO) and the breathing system unless they are specifically designed for such use. (If this is done, the oxygen flush flow will pass through the vaporizer and may result in gross overdosage when the flush valve is operated.)

7. ***The breathing system which conveys gases from the anaesthetic machine to the patient and disposes of expired gases is a vital part of the anaesthetic delivery system.***
   Because breathing systems require frequent cleaning and disinfection they are not a permanent part of the anaesthetic machine and therefore cannot be directly under the control of the anaesthetic machine manufacturer.
   However, we strongly recommend that only breathing systems which have been approved and authorised by Penlon for use with the Prima SP range should be employed.
   This is particularly important when mechanical ventilation is employed.

8. ***When mechanical ventilation is employed the patient breathing system must be connected directly to an over-pressure relief valve to prevent the possibility of barotrauma.***

WARNINGS AND CAUTIONS

9. Always perform a pre-use check of the machine, including vaporizers, ventilator, circle absorber and monitors before clinical use. Follow the pre-use checklist (see section 5) as a minimum requirement.
Many clinical accidents occur because of a failure to check for correct function.

10. The machine must not be used if any of the alarm, monitoring or protection system devices are not functioning correctly.

11. The machine must not be fitted with more than four operator accessible mains socket outlets. There is a risk of an excessive leakage current.

12. The use of antistatic or electrically conductive breathing hoses is not recommended when using high frequency electrical surgery equipment (e.g. : Diathermy).
Burns may be caused.

14. Before any electrically powered machine is used clinically for the first time, check that the hospital engineering department has carried out an earth continuity test.

15. Before using any additional electrical equipment powered by the auxiliary sockets on the machine, check that the additional equipment is correctly wired and is earthed through its plug. A missing or defective protective earth conductor may increase earth leakage currents to the patient to values exceeding the allowable limits, resulting in ventricular fibrillation, or interference with the pumping action of the heart.

16. Additional equipment placed on the top shelf must be securely attached. Take care when moving a fully loaded machine, particularly when negotiating ramps.
Check that hoses or power leads are not trailing on the floor.

CAUTIONS

1. Flowmeter needle valves are designed to seal with light torque and may be damaged if tightened excessively.
Take particular care with the carbon dioxide flowmeter control (if fitted); do not force the control knob past either the fully open or fully closed positions.

2. Open cylinder valves slowly to avoid damage to pressure reducing valves.
Ensure that cylinder valves are at least one full turn open when in use.

3. Under no circumstances should anaesthetic agents be used for cleaning purposes.

4. After use, always disconnect the machine from the piped gas supply and/or close the gas cylinder valves.

5. Mechanical AHD system - The oxygen flow control is restricted to prevent the needle valve from fully closing. This ensures a minimum basal flow of oxygen.
DO NOT attempt to close the flow to zero.
Do not overtighten.

6. Compressed gas supplies must be clean and dry.

7. When the auxiliary gas outlets are in use on a machine with cylinder supply only, or if the pipeline supply is not in use, check flow rate requirements, and ensure that adequate back-up cylinders are available.

NOTES

1. In the text, litres per minute is abbreviated to L/min to avoid confusion that may occur due to the typeface used in this manual.

2. All tightening torques, unless specified otherwise, are to the relevant Standard for each fixing type.

WARNINGS AND CAUTIONS- *O_2 Monitor*

Oxygen Monitor

WARNINGS

1. ***We recommend calibration of the oxygen monitor every time the system is turned on, as a safety precaution.***

2. ***Do not attempt to open the fuel cell. The sensor contains a small quantity of electrolyte, classified as a harmful irritant which is potentially hazardous.***

3. ***ALWAYS check the integrity of the sensor assembly before use. See section 3.4.***

4. ***Once exhausted, the sensor must be disposed of according to hospital, local, state and federal regulations.***

5. ***The sensor measures oxygen partial pressure, and its output will rise and fall due to pressure change.***
   An increase in pressure of 10% at he sensor inlet will produce a 10% increase in sensor output.

Using the oxygen monitor

6. ***When the battery voltage has fallen to the minimum safe level, the oxygen monitor will automatically shut down to avoid permanent damage to the battery.***
7. ***If the internal battery is fully discharged, the oxygen monitor will not function in the event of mains power failures.***
   The battery must be recharged before the oxygen monitor is used clinically, otherwise back-up time can not be guaranteed.
   See section 3.13.

CAUTIONS

1. *Do not sterilise the oxygen sensor or control unit components.*
   These components are not compatible with sterilisation techniques and damage may result.

2. *Do not autoclave or expose the sensor to high temperatures.*

3. *If the sensor shows signs of being affected by condensation, dry the sensor with soft tissue.*
   Do not use heat to dry the sensor.

NOTES

1. *The O2 SENSOR FAULT alarm indicates that one of the following conditions has occurred.*
   a) Internal electrical fault
   b) Software/electronics fault
   c) Oxygen sensor fault.

2. *The concentration read-out may, in certain conditions of excess pressure, show a value above 100%.*
   To accommodate these conditions it is possible to set the high alarm value up to 105% (see section 5).

3. *To maintain maximum sensor life, always remove the unit from the breathing circuit after use.*

2. PURPOSE

The Prima SP anaesthesia workstation range is intended to provide controlled concentrations and flows of anaesthesia gases into a patient breathing system, from where the anaesthesia ventilator and breathing circuit will then deliver this fresh gas mixture to the patient

Use the Prima SP in conjunction with anaesthetic vaporizers, breathing hoses and patient connection fittings which comply with the relevant ISO standard or equivalent.

Depending upon the patient circuit selected, the machines can be used in open, semi-open, semi-closed or closed circuit configurations.

The range has been designed to give a wide choice of configurations and accessories, as follows:

Machine size

Prima SP101 Induction machine with a single vaporizer on the backbar manifold, and up to three gas cylinders.

Prima SP102 Medium width machine with capacity for two vaporizers on the backbar manifold, and up to four gas cylinders.

Gas supplies

SP101 Up to three gases

SP102 Up to four gases:
Oxygen, nitrous oxide, carbon dioxide, and air (other options available), with pin-index cylinder yokes, and provision for up to three pipeline supply inlets.

Vaporizer mounting systems

Backbar manifold for Selectatec Compatible, or Cagemount type vaporizers.

Anti-hypoxic Device (AHD)

Machines can be specified with a mechanical AHD system, designed to minimise the risk of a hypoxic mixture reaching the patient, see section 3.

Oxygen monitor (optional)

The Oxygen Monitor is intended to continuously measure and display the concentration of oxygen in breathing gas mixtures used in anaesthesia, and is intended for adult, paediatric and neonatal patients.
The oxygen monitor is a module within an anaesthesia system.
The oxygen monitor is intended for use by health care providers, i.e. Physicians, Nurses and Technicians for use with patients during general anaesthesia.

3. DESCRIPTION

3.1 Framework and General Construction

Frame

The machine has a cast aluminium base, extruded aluminium uprights, with aluminium and plastic panels.

Mobility

Trolley models have four castors, with a brake on each of the front castors. The castors are five inches diameter.
A footrest is built into the front of the machine.
To aid manoeuvrability, two side handles are provided.

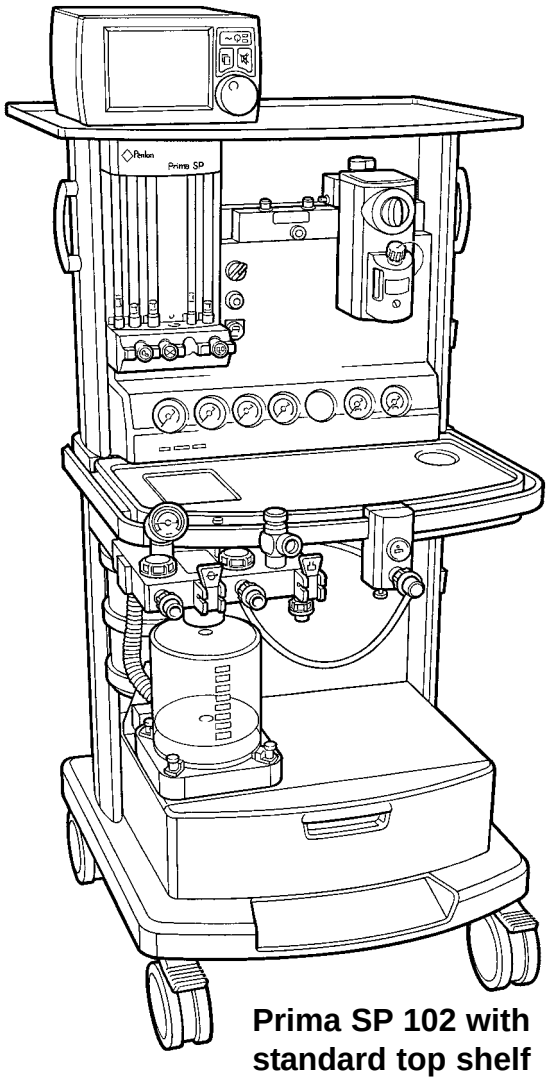
Mounting posts and brackets

A 'T-slot' mounting system is built into each side upright, to allow the use of pole-mount brackets, V-brackets, and ventilator mounting brackets.
The pole mount upright (see illustration) can be used to mount a complete AV-series Ventilator, or bellows unit only.
V-brackets can be used to mount a gas scavenging system, suction units, and accessories.

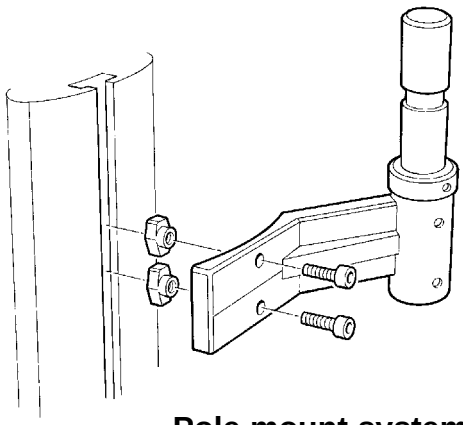
Draw units and work surfaces

The machine can be fitted with a base drawer unit (as illustrated) plus two additional smaller drawers.
The work surface has raised edges to prevent instruments, vials etc., from rolling off.

The Prima SP 102 illustrated on this page is equipped with a standard full-width top shelf unit suitable for a large monitor, and optional pull-out writing tablet mounted under the work surface.
Other options include additional high level shelves and a CPU tray mounted on the drawer unit.



Prima SP 102 with standard top shelf and base drawer unit



Pole mount system fitted to frame upright

DESCRIPTION

3.2 Gas Circuit

Gas Supplies

For each size machine, a variety of cylinder and pipeline combinations can be added to the basic specification of oxygen and nitrous oxide cylinder and pipeline supply.

For example, the Prima SP102 can be supplied with two extra gas cylinders (choose from one additional oxygen, one additional nitrous oxide, one carbon dioxide, one air), and one extra pipeline supply - Air.

Note
a) Kits are available for fitment to existing machines - see section 7 (Ordering Information).
b) Carbon dioxide is not available on US specification machines.
c) Helium and Xenon are available to special order

Cylinder Yokes

The cylinder yokes are rear mounted and conform with ISO standards for pin-index fitting.
To ensure that only cylinders of the appropriate gas may be installed the yokes are designed so that the retaining latch cannot be closed unless the index pins are fully engaged.

Pipeline Inlets

Machines can be fitted with up to three pipeline gas inlets mounted on the rear of the machine.

Pipeline supply hoses are connected by non-interchangeable, screw threaded unions (NIST).

Filters

To prevent dirt entering the gas system, cylinder yokes and pipeline inlets are fitted with filters.

Gas Inlet Block

Each individual gas supply, from a cylinder or pipeline, is routed through a separate gas block.
Each gas block has an integral high pressure gauge tapping for direct mounting of a pressure gauge, and a non-return valve to prevent back flow of gas.

In addition, gas blocks for cylinder supplies have a diaphragm pressure regulator to reduce the pressure of the compressed gas supply, and a pressure relief valve, factory set to prevent any pressure build up under the diaphragm should any leakage develop across the reducing valve seat.

Secondary Pressure Regulator

For oxygen, nitrous oxide, and air, a second stage regulator reduces the pressure supplied to each flowmeter controls (see section 4.8).

The fitment of a secondary regulator for oxygen and nitrous oxide enhances the performance of the mechanical AHD system (if fitted).

Secondary regulation of the air supply is also utilised to allow connection to high pressure (7 bar) air pipeline supplies.

Carbon Dioxide Flow Restrictor

On machines with a carbon dioxide supply, an integral, factory set, flow valve is fitted to restrict the flow of carbon dioxide to 500 ml/min.

3.3 Gas Circuit Schematics

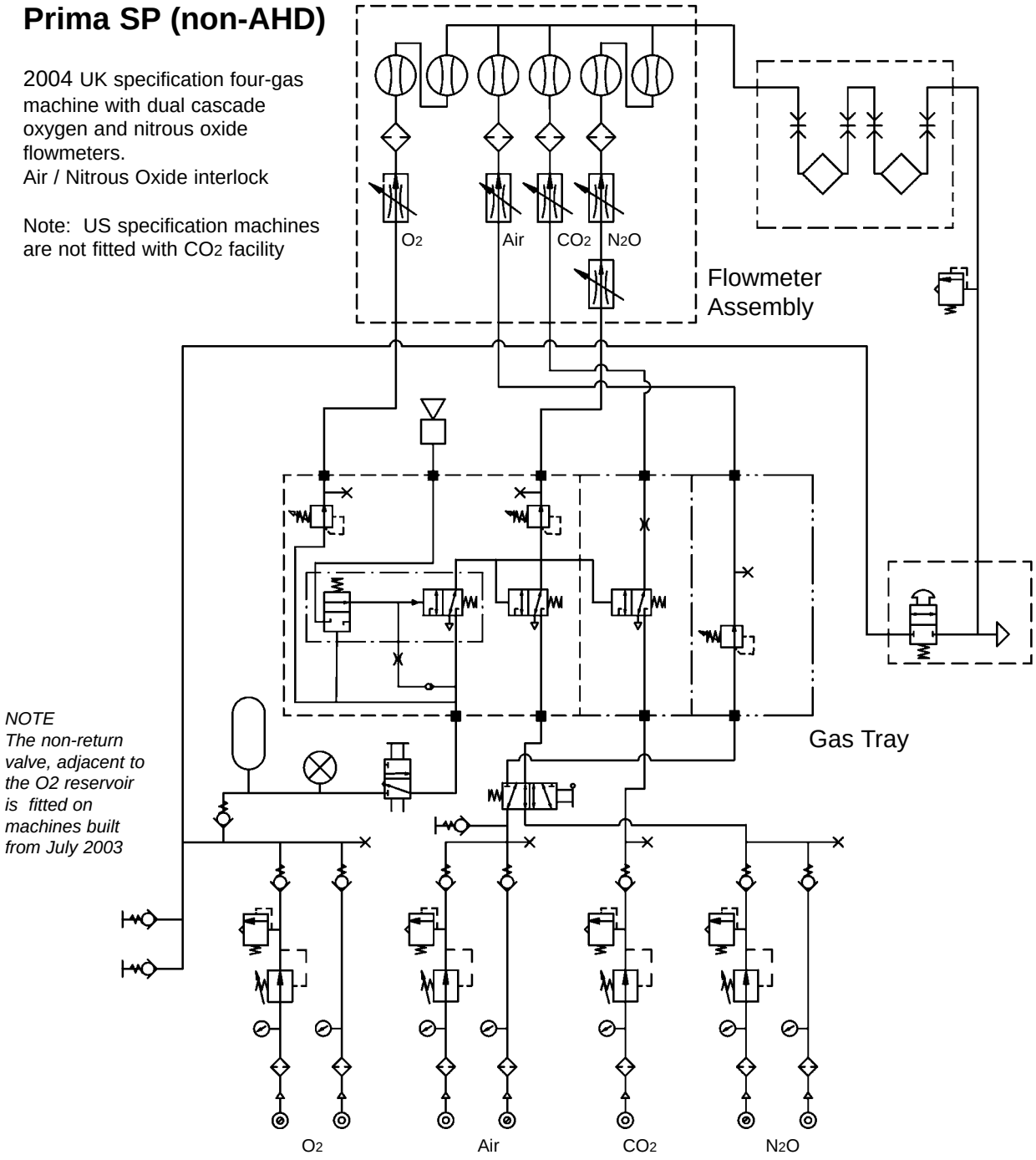
Gas circuit schematics for:
a) Non-AHD machines
b) Mechanical AHD machines
are shown on the following pages, and both show a four-gas machine.
All available gas supply options are shown.

Note that carbon dioxide is not available for US specification machines.

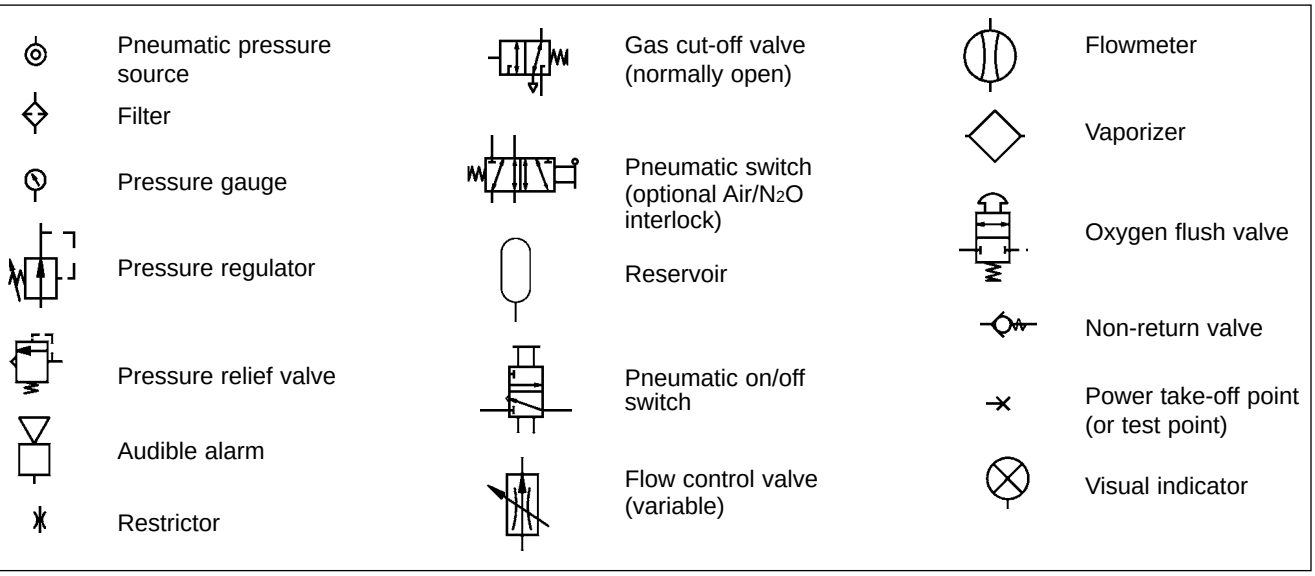
Prima SP (non-AHD)

2004 UK specification four-gas machine with dual cascade oxygen and nitrous oxide flowmeters.
Air / Nitrous Oxide interlock

Note: US specification machines are not fitted with CO_2 facility



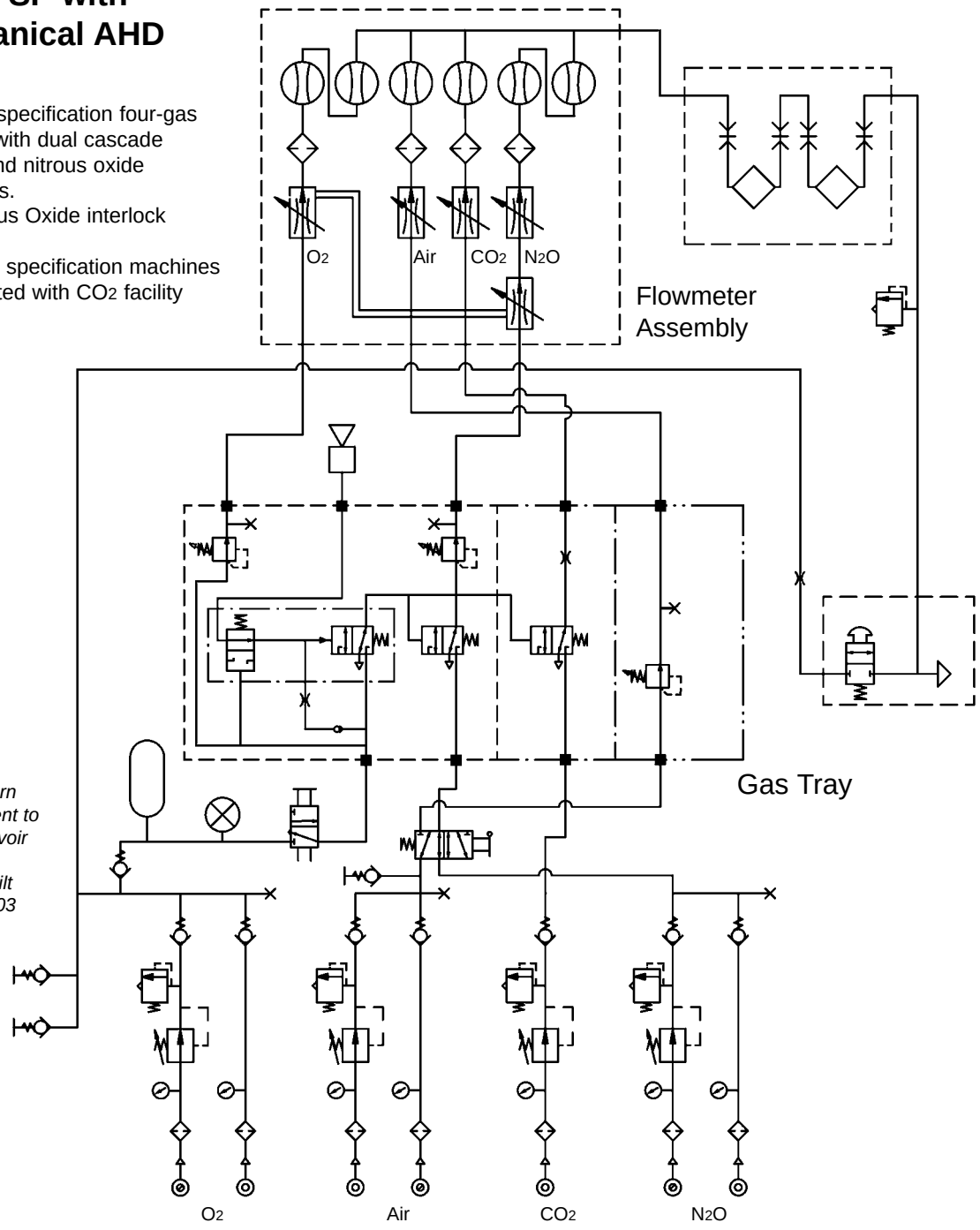
NOTE
The non-return valve, adjacent to the O2 reservoir is fitted on machines built from July 2003



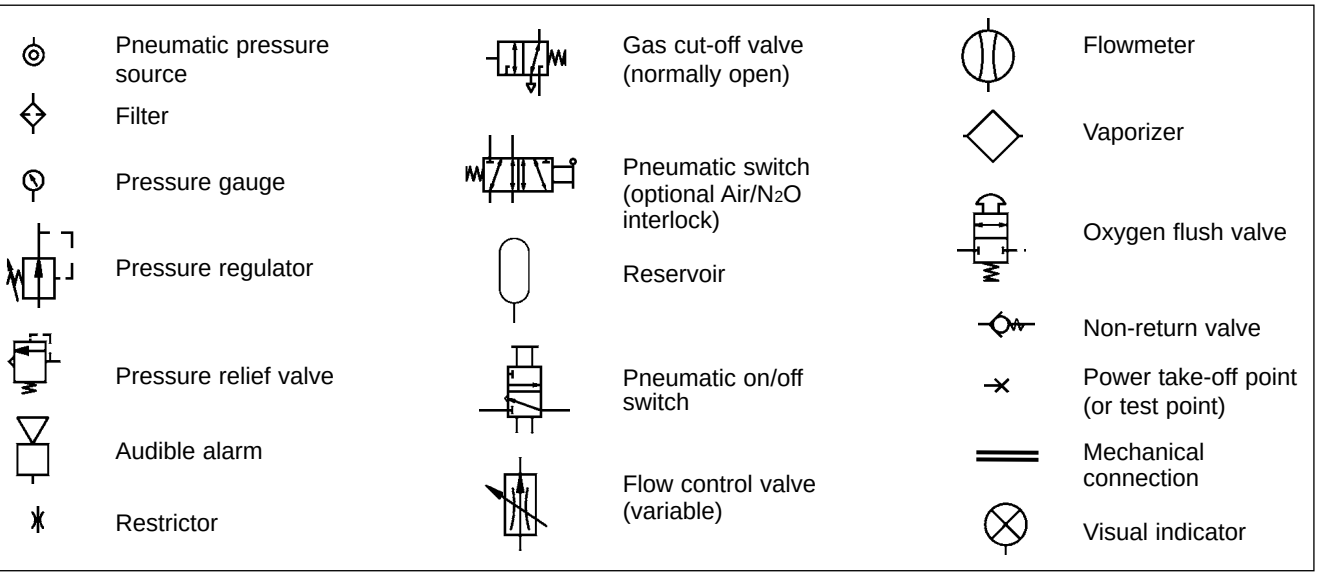
Prima SP with Mechanical AHD

2004 UK specification four-gas machine with dual cascade oxygen and nitrous oxide flowmeters.
Air / Nitrous Oxide interlock

Note: US specification machines are not fitted with CO_2 facility



NOTE
The non-return valve, adjacent to the O2 reservoir is fitted on machines built from July 2003



DESCRIPTION

3.4 Gas Supply Safety Devices

3.4.1 Gas Supply Cut-off Device

A gas cut-off device, triggered by low oxygen supply pressure, cuts the supply of nitrous oxide, and carbon dioxide (if fitted).

The cut-off operates when the oxygen pressure falls to 186 ±14 kPa (27 ±2 psig).

Gas supplies are reinstated only when the oxygen supply pressure rises above 227 ±14 kPa (33 ±2 psig).

3.4.2 Oxygen Supply Failure Warning Whistle

A whistle gives an audible warning when there is a reduction of oxygen supply pressure.
Operated solely by the remaining oxygen in the machine system, the warning whistle is prolonged by an oxygen reservoir built into the gas circuit, allowing a minimum warning whistle of 7 seconds duration.

The whistle will start to sound when the pressure falls to 200 ±21kPa (29 ±3 psig), and will continue to sound until the pressure falls to approximately 70 kPa (10 psig).

Oxygen consumption of the whistle is approximately 2 L/min when sounding and nil at other times.

3.4.3 Fresh Gas Pressure Relief Valve

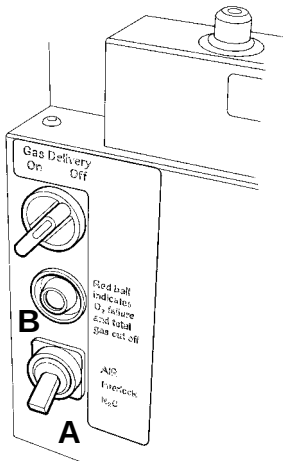
A pressure relief valve is mounted between the vaporizer back bar and the common gas outlet (CGO) on the inside face of the machine right hand upright.

It is designed to prevent fresh gas being delivered to the breathing system at pressures exceeding 41 kPa (6 psi).
This valve also protects machine components against excessive pressure in the event of a total blockage of the CGO.

3.4.4 Air/N_2O Interlock (optional)

The user can switch between Air and Nitrous Oxide (A).

NOTE
a) The machine will NOT deliver a mixture of Air and nitrous oxide.
b) On machines with Mechanical AHD, the O_2/N_2O linkage continues to operate.



3.4.5 Oxygen Supply Visual Indicator

The indicator (B) is operated from the oxygen supply and shows GREEN when the supply is at working pressure, and RED if the pressure falls.

3.4.6 CO_2 Flow Restriction

The maximum flow of carbon dioxide is restricted to 500 ml/min by a pre-set flow control valve.
This valve is not user-adjustable.
Note that carbon dioxide is not available for US specification machines.

3.4.7 Mechanical AHD

A mechanical link between the oxygen control valve and a needle valve in the nitrous oxide flow ensures that the machine delivers a fresh gas mixture with a minimum 27% oxygen, irrespective of the flow of nitrous oxide set by the anaesthetist.
With the nitrous oxide control valve fully open, the oxygen and nitrous oxide flows are then both controlled by the oxygen control valve.
See section 3.5 for a full description

3.4.8 Low Pressure Gas Tubing

Diameter-indexed tubing is used for the low pressure gas system - see section 4.

DESCRIPTION

3.5 Mechanical AHD (Anti Hypoxic Device)

3.5.1 Introduction

The Mechanical AHD is housed within the flowmeter module and comprises a gear linkage between the oxygen control valve and a needle valve in the nitrous oxide flow.

The system is designed to control the relative flow rates of oxygen and nitrous oxide.
A predetermined minimum oxygen concentration of 30% ±3% in the oxygen / nitrous oxide mixture is maintained over the flow range to ensure that a hypoxic mixture is not supplied from the anaesthetic machine.

3.5.2 Gas Delivery Switch

The Gas Delivery Switch (A) operates on the oxygen supply and must be in the 'On' position for normal operation of the anaesthetic machine.

The switch consequently controls the supply of all gases provided with a gas cut-off triggered by a predetermined pressure level within the oxygen supply (see section 3.4.1).

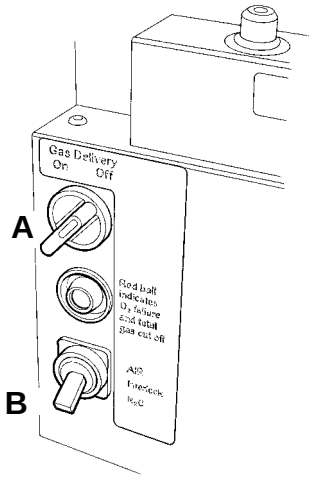
A whistle (oxygen failure warning whistle) will sound briefly whenever the gas delivery switch is turned on or off. Note that the whistle functions continuously if the oxygen supply fails (see section 3.4.2).

NOTE
The switch also controls the electrical supply to the optional flowmeter lighting unit, oxygen monitor and integrated AV900 V4 ventilator.

3.5.3 Gear Linkage and Nitrous Oxide Control Valves

A gear linkage connects the oxygen control knob on the flowmeter module and a needle valve in the nitrous oxide flow. This linkage limits the flow of nitrous oxide relative to the flow of oxygen set by the user.
Note that this needle valve acts as the primary nitrous oxide valve, and is actuated only by movement of the oxygen control.

NOTE
Machines with Air option have the additional



option of an Air/N_2O Interlock switch (B).
The machine will NOT deliver a mixture of Air and nitrous oxide - see section 3.4.4) .
This switch must be in the N_2O position to allow a flow of Nitrous Oxide.

The nitrous oxide control knob on the flowmeter module operates a secondary needle valve in the nitrous oxide flow. It is positioned downstream of the primary valve and therefore is used only to restrict the flow already set by the primary valve, which itself has been determined by the position of the oxygen control knob.

Therefore, for any oxygen flow set by the user, the mixture delivered will still contain a minimum 30% ±3% oxygen even with the nitrous oxide control knob fully open.
As the nitrous oxide knob is progressively closed, the oxygen content of the mixture increases to 100%.

3.5.4 Oxygen Basal Flow

To allow the system to function correctly, an oxygen basal flow is continuously supplied.

Single Flow Tubes: 100 - 200 ml/min
Dual Cascade System Flow Tubes: 50 - 75 ml/min

This basal flow can only be turned on and off by using the Gas Delivery Switch.

CAUTION
The oxygen control is restricted to prevent the needle valve from fully closing. This ensures a minimum oxygen basal flow.
DO NOT attempt to close the flow to zero. Do not overtighten the knob.

3.6 Pressure Gauges

Pressure gauges (50 mm diameter) are located on the front panel below the flowmeter bank.

The gauges for the third and fourth gases (if fitted) are positioned between oxygen and nitrous oxide. Unused gauge positions are blanked out.

All pressure gauges are colour coded and labelled for the gases whose pressures they are indicating.

Cylinder gauges are marked: CYLINDER.
Pipeline gauges are marked: PIPELINE.

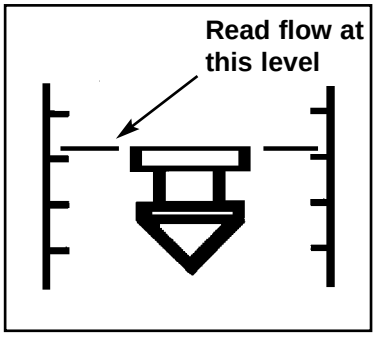
The gauges are calibrated in kPa x 100.

DESCRIPTION

3.7 Flowmeters and Controls

3.7.1 All models

The flowmeters, mounted behind the perspex cover on the left hand side of the machine, are length-indexed to prevent inadvertent, incorrect installation.
All floats indicate flow rate in line with the upper surface as shown below.



Each flow control valve is positioned directly underneath the flow tube assembly to which it corresponds, and the control knob is colour-coded for the gas which it controls.

The oxygen flow control knob is made physically distinguishable from the other flow controls for identification by touch in accordance with ISO standards.

When fitted, air and carbon dioxide flowmeters are always installed in the inner positions on the flowmeter assembly. These positions are blanked out if air or carbon dioxide are not specified for the machine.

NOTE
Machines with an Air supply option have the additional option of an Air/N_2O Interlock switch (The machine will NOT deliver a mixture of Air and nitrous oxide - see 3.4.4) .
On these machines, this switch must be in the N_2O position to allow a flow of Nitrous Oxide.

The gas delivery switch, positioned to the right of the flowmeter bank, controls the supply of oxygen and must be in the ON position for normal operation of the machine.

Flow control of each gas is achieved by a needle valve comprising a polished stainless steel needle mounted concentrically in a common manifold block. To minimise wear and material pick-up the needle seat is manufactured from silver. The flow control knob is turned counter-clockwise to increase the gas flow.

CAUTION
Needle valves are designed to seal with light torque and may be damaged if tightened excessively.
DO NOT USE EXCESSIVE FORCE.

3.7.2 Optional Dual Cascade Flow Tubes

The flow of gas through dual cascade system flow tubes always flows through the low-flow tube first. The high-flow tube should not show any flow until more than 1 L/min is set.

At flows above 1 L/min, the high-flow tube reading indicates the rate of flow for that gas.

3.7.3 Carbon Dioxide Flow Restriction

The maximum flow of carbon dioxide (if fitted) is restricted to 500 ml/min.

DESCRIPTION

3.8 Vaporizers

CAUTION
Read the instruction manual supplied with the vaporizer before clinical use.

3.8.1 Vaporizer Mounting Systems

Vaporizers for the administration of volatile anaesthetic agents can be fitted to customer's requirements as follows:

(a) Up to two Penlon Sigma Delta Selectatec compatible vaporizers, mounted on a Selectatec compatible universal backbar.
(b) One or two Penlon Sigma Delta Cagemount vaporizers mounted on a Modura rail (check that relevant national standards for your country allow fitment of more than one cagemount type vaporizer).

WARNING
Vaporizers must always be securely mounted, and never used free-standing.
Unmounted vaporizers may be accidentally tipped resulting in uncalibrated and excessive volumes of liquid anaesthetic drug entering the breathing system.

Vaporizers of any description must not be installed or connected between the Common Gas Outlet (CGO) and the Breathing System, unless they are specifically designed for such use. (If this is done, the oxygen flush flow will pass through the vaporizer, and severe overdosage may result).

3.8.2 Selectatec Compatible Vaporizers

Selectatec compatible vaporizers, (e.g. the Sigma Delta with the Selectatec connector block), may be mounted on a universal back bar manifold, built onto the Prima SP range as an option.

Single and two-station manifolds are available, with each station fitted with two valve capsule assemblies for vaporizer connector block attachment.

When a vaporizer is installed on a station the valves on that station open automatically to allow gas flow into and out of the vaporizer. Removal of the vaporizer from the station closes the valves on that station.

Selectatec compatible vaporizer interlock systems are described in the literature supplied with the vaporizer.

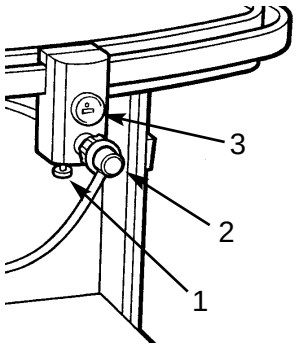
3.8.3 Cagemount Vaporizer

Vaporizers fitted with cagemount tapers have the male taper (inlet port) on the left, and the female taper on the right (viewing the front of the vaporizer).

It is recommended that detachable cagemount connectors are retained with a safety clip (catalogue number 52275) to prevent inadvertent disconnection.

DESCRIPTION

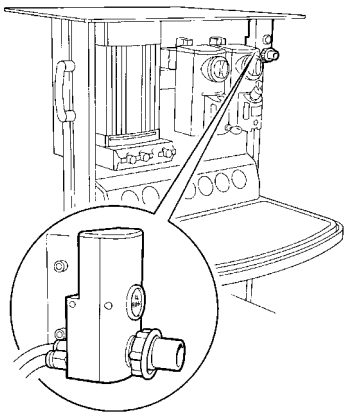
3.9 Common Gas Outlet (CGO) Block



The CGO block is mounted on the rail on the front of the machine, and can be moved along the rail. Slacken the securing screw (1) under the block and carefully slide the block along the rail to the required position.
Tighten the screw to hold the block in place.

The fresh gas outlet (2) is located on the front face of the block, with 22 mm male taper and concentric 15 mm female taper. The male taper incorporates the Penlon Safelock system designed to prevent accidental disconnection of the breathing system.

A high mounting position for the CGO is available as an option for all machines.



Optional high mounting position

Oxygen Flush
An emergency oxygen flush valve button (3) is mounted on the top front of the CGO block and is marked 'O_2 FLUSH'.
Depressing the button provides a delivery of between 35-75 litres/min of oxygen into the common gas outlet (2).
Releasing the button allows the spring-loaded valve to return to its normal position.

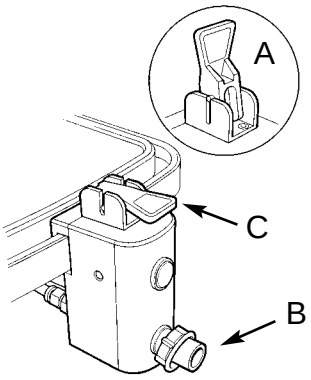
Optional two-position Switch on CGO

An optional switch on the CGO outlet enables the user to choose to divert the fresh gas flow:

a) directly to the absorber, or
b) through the CGO outlet to an open patient circuit.

Switch in vertical position (A)
The fresh gas flow is directed to an open patient circuit via the outlet (B) on the front of the common gas outlet.

Switch in horizontal position (C)
The fresh gas flow is directed to the absorber via tubing connected to the rear outlet of the common gas outlet block.



Optional CGO switch

DESCRIPTION

3.10 Electrical Power Supply (if specified)

3.10.1 Mains Power Supply

Power is fed to the machine via the mains lead, to power an auxiliary output panel, and optional flowmeter bank light.

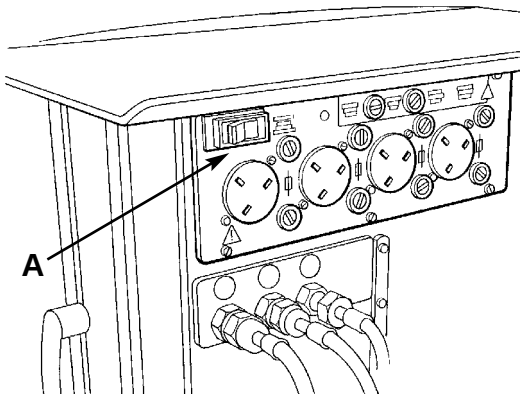
NOTE

a) It is the user's responsibility to ensure that the total sum of leakage currents from additional equipment plugged into the auxiliary sockets plus the leakage current from the machine does not exceed the values specified in any relevant national standards that may apply in the country where the machine is in use.

b) Each socket is protected with two 5 A fuses.

3.10.2 Auxiliary Power Supply Sockets (if fitted)

An optional mains electricity auxiliary panel with three or four sockets can be specified, and fitted to the rear of the machine.



The supply to the sockets is controlled by an ON/OFF switch (A), which also incorporates a circuit breaker.

3.10.3 Flowmeter Bank Lighting (Optional)

The lighting system is controlled by the main ON/OFF switch (A).

3.10.4 AV900 or AV800 Ventilator (if fitted) Power Supply

The mains lead for an AV-series ventilator can be plugged into one of the auxiliary power sockets on the rear of the machine.

AV900 V4 with interface link to Prima SP
(See section 3.15)

a) Turn the machine Gas Delivery Switch ON. The ventilator will power-up.

b) While the Prima SP power is ON, the Ventilator can be turned OFF and ON, using the ventilator On/Off switch.

c) Turn the Gas Delivery Switch to OFF. The ventilator will power-down.

Ventilator Back-up Battery

If the power supply to the ventilator fails, the ventilator back-up battery will power the ventilator for 60 minutes, if the battery has been maintained in a fully charged condition. Refer also to the user instruction manual supplied with the ventilator

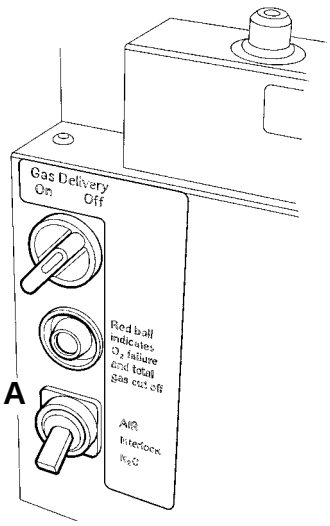
Battery charging takes place automatically when the ventilator mains lead is connected to a 'live' mains supply.
The OFF indicator on the ventilator front control panel will show a yellow light during charging.

NOTE
The stated battery back-up period will only be available if the battery is kept fully charged.
If the battery has been allowed to discharge below the LOW BATTERY condition, the ventilator will not function correctly until the voltage raises above the LOW BATTERY level.
A fourteen hours recharge will be necessary to bring the battery to full charge.

3.10.5 Monitor and other Accessories (if fitted)

The mains lead (or adaptor) for a monitor system or other accessories requiring an electrical supply can be plugged into one of the auxiliary sockets on the rear of the machine.
Penlon Oxygen Monitor - see section 3.13.7.

3.11 Third/Fourth Gas Options



3.11.1 Air

When air is specified as the third/fourth gas, the machine specification is modified as stated in 4.10.1.

NOTE

Machines with an Air supply option can be fitted with an optional Air/N_2O Interlock switch (A)

The machine will NOT deliver a mixture of Air and nitrous oxide - see section 3.4.4.

This switch must be in the N_2O position to allow a flow of Nitrous Oxide.

3.11.2 Carbon Dioxide

When carbon dioxide is specified as the third/fourth gas, the machine specification is modified as stated in 4.10.2.

Gas supply cut-off devices operate on carbon dioxide in all machines.

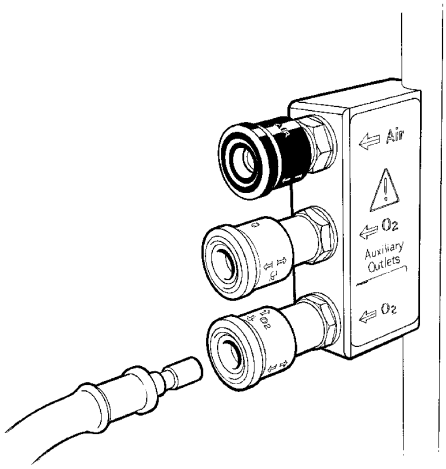
An integral flow restrictor is fitted to reduce the flow of carbon dioxide to 500 ml/min.

Note that carbon dioxide is not available on US specification machines.

3.12 Auxiliary Gas Outlets

CAUTION

When the auxiliary gas outlets are in use on a machine with cylinder supply only, or if the pipeline supply is not in use, check flow rate requirements, and ensure that adequate back-up cylinders are available.



Oxygen

Auxiliary oxygen outlets are mounted on the right hand side frame upright.

Air

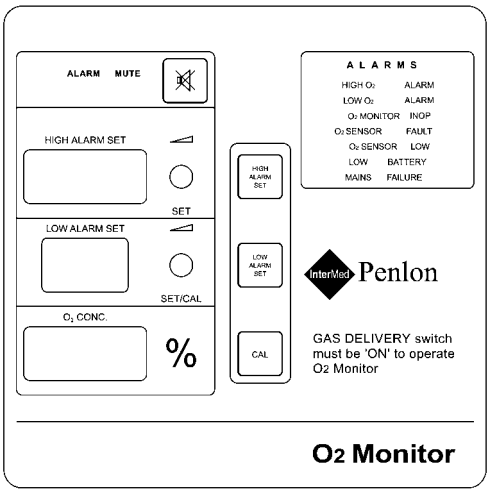
On machines fitted with an air cylinder/pipeline supply, an auxiliary air outlet is fitted above the oxygen outlets.

Supply pressure

See section 4.5

3.13 Oxygen Monitor (Optional)

The oxygen monitor continuously measures and indicates the concentration of oxygen in the breathing system, and triggers an alarm when the concentration varies from the set levels.



CAUTION
If your machine is fitted with an AV900 Ventilator with a built-in Oxygen Monitor, please refer to the AV900 user manual for instructions on setting up and operation.

3.13.1 System Description

The Oxygen Monitor uses a fast-responding, oxygen-specific, self powered sensor that achieves 90% of final value in less than 10 seconds.

Sensor life:

approximately 1,500,000 O_2 percent hours at 20^{O}C
(minimum one year in most normal applications).

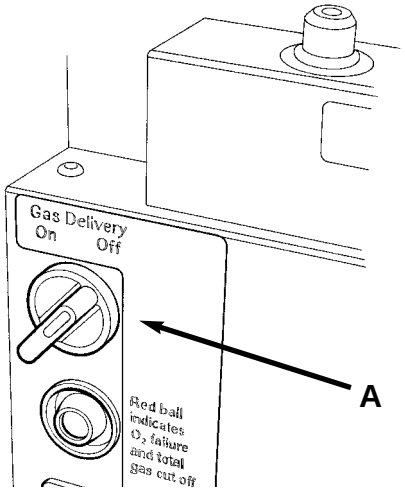
An external probe is supplied with a 2 m (6 ft) extendable cable and diverter fitting for a standard 15 mm Tee adaptor.

The system has user-adjustable high-level and low-level alarms with visual and audible indication of alarm conditions.

Easy-to-read, seven segment LED display for high-set, low-set, and oxygen concentration readings.

The monitor is controlled by the machine gas system master On/Off switch (A).

A back-up battery provides a minimum of 60 minutes operation in the event of mains failure.
The battery is charged when the machine is connected to the mains supply.



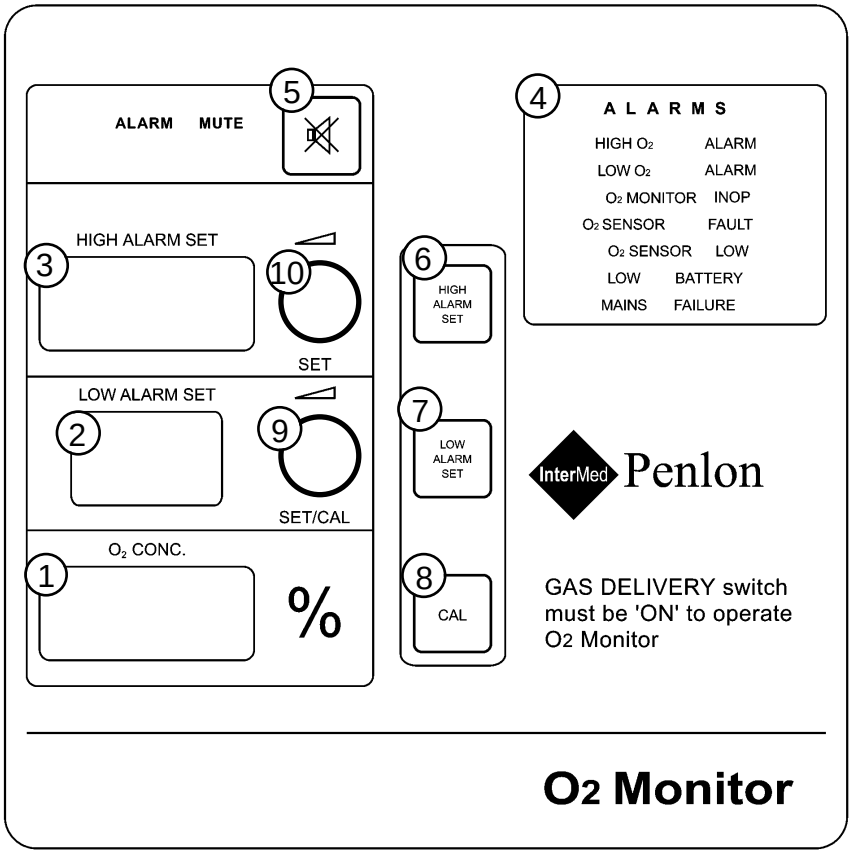
3.13.2 System On/Off Switch

The switch (A) controls gas delivery from the anaesthetic machine, and electrical power to the oxygen monitor.

The switch must be in the **On** position to use the oxygen monitor and anaesthetic machine.

When switched to **On**, the monitor will always default to previous settings.

DESCRIPTION - *O2 Monitor*



Oxygen monitor control panel

1. O2 Concentration display
2. Low alarm set/calibration display
3. High alarm set
4. Alarm LEDs
5. Alarm mute key
6. High set key
7. Low set key
8. Calibrate key
9. Low alarm set / Calibration control
10. High alarm set control

3.13.3 Displays

Oxygen Percentage Readout
The display provides direct readout of oxygen concentrations in the range of 0-100%.
If the oxygen concentration exceeds 100%, the display will flash.

Low Alarm Set Readout
The indicated value represents the oxygen percentage at which the low alarm will be activated.
The low alarm set value is limited within 18-99%.
To set the low oxygen concentration alarm, see section 5.12.

High Alarm Set Readout
The indicated value represents the oxygen percentage at which the high alarm will be activated.
The high alarm set value is limited within 19-105% (Note that in certain conditions of excess pressure, the readout may show a value above 100%.)
To set the high oxygen concentration alarm, see section 5.12.

3.13.4 Alarm Conditions

HIGH O2 ALARM
The high O2 alarm is triggered when the oxygen concentration is 1% above the setting.
In this alarm condition, a red HIGH O2 ALARM LED will flash at a 0.5 second rate, accompanied by a high priority sound.
To cancel this alarm, the high alarm setting must be equal to, or above the oxygen concentration.

LOW O2 ALARM
The low alarm is triggered when the oxygen concentration is 1% below the setting.
In this alarm condition, a red LOW O2 ALARM LED will flash at a 0.5 second rate, accompanied by a high priority sound.
To cancel this alarm, the low alarm setting must be equal to, or below the oxygen concentration.

O2 MONITOR INOP (inoperative)
This alarm indicates when the oxygen monitor is in malfunction condition.
The alarm can be triggered by electronic components failure or software malfunction.
In this alarm condition, a red O2 MONITOR INOP ALARM LED will flash at a 0.5 second rate, accompanied by a high priority sound.
If this mode occurs you can reset the system by pressing the ALARM MUTE and LOW ALARM SET buttons simultaneously for 3 seconds.

O2 SENSOR FAULT
The alarm is triggered:
a) when either the oxygen sensor is disconnected or approaching the end of its life.
b) if the the oxygen concentration exceeds 110%.
In the alarm condition, a red O2 SENSOR FAULT ALARM LED will flash at a 0.5 second rate, accompanied by a high priority sound.
To cancel this alarm, check the sensor connection or replace the sensor.

O2 SENSOR LOW
This alarm indicates the sensor has approached the end of its life.
The yellow O2 SENSOR LOW LED will light up, and a low priority sound will be triggered.
The sensor must be replaced as the output will fall very quickly to zero within two to three weeks of normal usage.
See section 6 for sensor replacement.
NOTE
To maintain maximum sensor life, always remove from breathing circuit after use.

LOW BATTERY
This alarm indicates that the battery is disconnected or the battery voltage has dropped below acceptable limits.
If the monitor is in use under battery power, and the battery voltage is less than 11.5 volts, a low priority alarm is triggered, to indicate that the battery has less than 20 minutes life left.
If the battery voltage falls to less than 10.8 volts a flashing medium priority alarm is triggered to indicate there is less than 5 minutes power left in the battery.
To cancel this alarm, mains power must be On.

NOTE If this condition persists, contact your Penlon Service Centre, or Penlon Customer Service Department in the UK.

At the end of the final 5 minute warning period, the oxygen monitor will shut down, to prevent damage to the battery.

MAINS FAILURE
This alarm indicates mains power failure or cut-off. The yellow MAINS FAILURE LED will illuminate, and a low priority sound will be triggered.

3.13.5 Alarm Mute

In an alarm condition, pressing the ALARM MUTE button will deactivate the alarm sounder but the alarm LED will continue to flash. The yellow MUTE ALARM LED will illuminate, accompanied with a SINGLE ‘beep’ sound.

The alarm mute cannot be operated:
a) until the mute time is over, or the alarm condition has been rectified.
b) when the oxygen concentration drops below 18%.

In high priority and medium alarm conditions the alarm mute deactivates the sounder for 30 seconds and 120 seconds respectively.

DESCRIPTION - *O2 Monitor*

3.13.6 The MOX-3 Oxygen Sensor

The MOX-3 oxygen sensor offers quick response, linear output over the entire 0-100% oxygen range, and long service life.

The MOX-3 is a self-powered galvanic cell that generates a current proportional to oxygen concentration.

The cell has a highly stable output over its operating life. Significant output loss is only shown at the very end of its life.
Typical sensor drift rates are less than 1% per month when the sensor is exposed to gas in typical applications.
Sensor lifetime is governed by the mass of lead available to react with the oxygen and its rate of consumption. High oxygen partial pressure and high temperature will increase the sensor output current, thus shortening the operation life.
At the point where all lead has been consumed, the output will fall very quickly to zero over a period of two to three weeks.

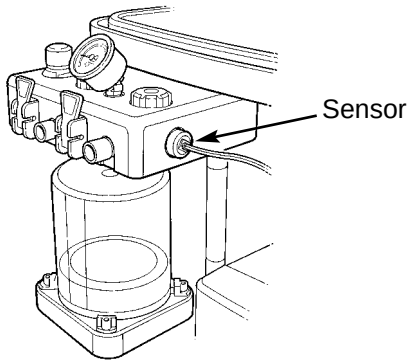
NOTE
To maintain maximum sensor life, always remove from breathing circuit after use.

Sensor Location

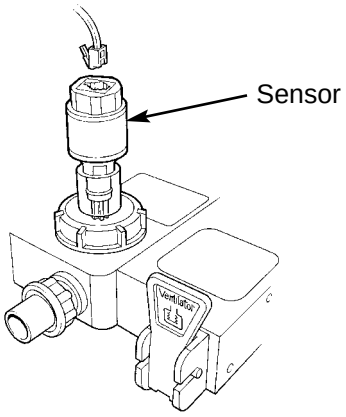
The sensor assembly consists of an external probe and 2 m (6 ft) cable.

1. Prima SP with A100SP Absorber

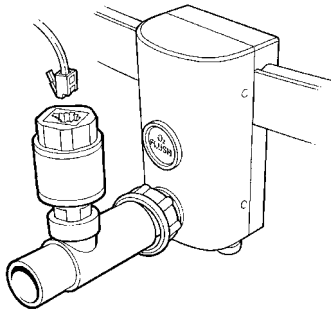
Please refer to the datasheet, Doc No A100SP 103DS(U), supplied with the absorber.



2. Mounted on the dome of the absorber inspiratory valve



3. 'T' piece adaptor on CGO block



3.13.7 Power Supply - O2 Monitor

Mains Power Supply

Power is fed to the machine via the mains lead to a switching mode power supply.
The oxygen monitor is powered by 14.2 V.
The monitor is controlled by the machine gas system master On/Off switch (see 3.13.2).

Back-up Battery

Should the electrical power supply to the machine fail, the emergency battery supply for the unit comes into action automatically.
This is indicated by the illuminated yellow 'MAINS FAILURE' LED alarm, accompanied by a single audible tone.
The battery is maintained in a fully charged state during normal use (i.e. the machine connected to the mains power supply).
A fully charged battery will power the unit for a minimum of 60 minutes.

Low Priority Battery Low Alarm

When the battery is discharged, and the mains power supply is not restored, the 'BATTERY LOW' LED alarm will illuminate, accompanied with a low priority alarm sound.

Medium Priority Battery Low Alarm

When the battery is further discharged, and the mains power supply is not restored, the 'BATTERY LOW' LED will flash at a two second rate and a medium priority audible warning will be given when the minimum safe level of voltage is reached.

Low Battery Shut Down

WARNING

When the battery voltage has fallen to the minimum safe level, the oxygen monitor will automatically shut down to avoid permanent damage to the battery.

Recharging the Battery

Charging of the back-up battery takes place automatically when the mains power supply is on, irrespective of the position of the machine gas system On/Off switch position.

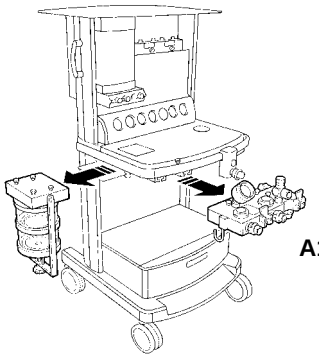
NOTE

The stated battery back-up period will only be available if the battery is kept fully charged. After the back-up power supply has been run down, the oxygen monitor will not function until the battery is recharged.
An eight hours recharge will be necessary to bring the battery to full charge.

DESCRIPTION

3.14 A100 / A100SP Absorber

A100 Absorber In-board Mounting
The canister and valve block assemblies are mounted under the work surface and can be detached separately for cleaning (section 6).

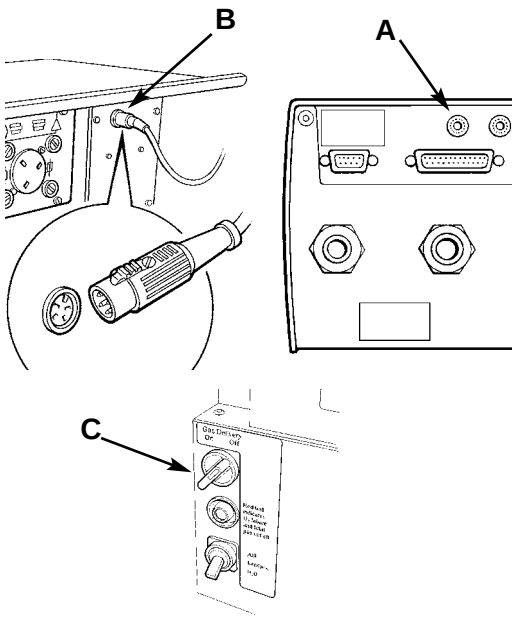


A100 Absorber

A100SP Absorber
Please refer Appendix 4.

3.15 AV900 V4 Ventilator

Interface to Prima SP
The interface cable links the socket (A) at the rear of the ventilator control unit to socket (B) on the rear panel of the anaesthetic machine.



AV900 V4 ON/OFF function

a) Turn the machine Gas Delivery Switch (C) ON.
The ventilator will power-up.

b) While the Prima SP power is ON, the Ventilator can be turned OFF and ON, using the ventilator On/Off switch.

c) Turn the Gas Delivery Switch to OFF.
The ventilator will power-down.

3.16 Prima SP System - MRI Compatibility

CAUTION *Field strengths vary at individual MRI facilities - for additional information, contact Penlon Ltd.*

The following system components are MRI compatible:

1. Prima SP basic* machine
**A 'basic' machine includes any variant of*

Back Bar	*Flowmeter Bank*
Drawers	*Monitor Shelves*
Additional Gases	

2. A100 and A100SP Absorber
(Non-magnetic inspiratory/expiratory valve discs must be fitted - Part No. 2930-623).
CAUTION *A100SP Absorber is normally part of an Prima SP integrated system with the AV900 V4 ventilator - this system is <u>not</u> MRI compatible.*

3. Nuffield 200 Ventilator

4 . Delta Vaporizer

The following components are currently <u>not</u> MRI compatible:

1. Oxygen Monitor
2. Flowmeter lighting
3. Electrical power outlets
4. AV-series ventilator

NOTE

a) MRI Compatible Plastic Laryngoscopes - see section 3.9 in the Penlon Price List.

b) The IDP Pressure Failure Alarm must be:
a) mounted securely and
b) fitted with appropriate batteries - see section 1.5 in the Penlon Price List.

4. SPECIFICATION

4.1 Physical Dimensions

Overall frame size:	Height x Width x Depth (cm)
SP 101	139 x 45 x 70
SP 102	139 x 71 x 70
Work surface	
Height:	86 cm
Size:	SP 101: 45 cm x 25 cm SP 102: 58 cm x 25 cm
Loading:	30 kg (66 lb) - evenly distributed.
Writing tablet:	30 x 22 cm
Top shelf:	SP 101: 58.5 cm x 35 cm SP 102: 71 cm x 35 cm
Loading:	30 kg (66 lb) - evenly distributed.
Base Drawer:	Prima 101: 16 x 37 x 35 cm Prima 102: 12 x 54.5 x 35 cm
Loading:	10 kg (22 lb) evenly distributed
Castors:	Front pair braked
Ventilator bellows post	Bushed to accept 25.4 mm (1 inch) or 22 mm (7/8 inch) poles.
Loading	30 kg (66 lb)
Gas scavenging fixing	Bracket on frame upright
Loading	30 kg (66 lb)
Common gas outlet:	22 mm male taper with coaxial 15 mm female taper connections, Safelock fitting

Weight (approximate, depending on specification):

SP 101	70 kg (154 lb)
SP 102	75 kg (165 lb)

SPECIFICATION

4.2 Gas Supplies

Cylinders: Oxygen, nitrous oxide, air, and carbon dioxide cylinder fittings can be specified to the maximum numbers given below.
All cylinder yokes are pin-indexed

SP 101	Maximum of three
SP 102	Maximum of four

Special order options: Helium, Xenon

Pipeline:

SP 101/102 Maximum of three (oxygen, nitrous oxide, air).
All to relevant national standards.

Medical gas colour codes:

Oxygen	White* or Green
Nitrous oxide	Blue
Medical air	Black/White* or Yellow
Carbon dioxide	Grey
Helium	Brown
Xenon	Green (bright)

*To comply with relevant national standards.

Internal pipework is diameter indexed for each gas:

Oxygen:	8 mm	Carbon Dioxide:	4 mm
Nitrous oxide	6 mm	Helium	4 mm
Air	5 mm	Xenon	4 mm
Mixed gas	10 mm		

4.3 Flowmeters

Flow ranges:

Single flow tubes

Oxygen:	0 - 10 L/min
Nitrous Oxide:	0 - 10 L/min
Air	0 - 10 L/min
Carbon Dioxide	0 - 500 ml/min (flow limited to 500 ml/min)
Helium	0 - 10 L/min

Cascade flow tubes

Oxygen /Air /Nitrous Oxide	(1)	0 - 1000 ml/min
	(2)	0 - 10 L/min

Flowmeter Accuracy

The accuracy of the flowmeter tubes is ± 2.5% of full scale reading.

SPECIFICATION

Flowmeter construction and dimensions
Tubes and floats are matched, and must not be interchanged.
Flowmeter tubes have antistatic coatings.

Tubes are length indexed:

Oxygen	260 mm (10.24 inch)
Nitrous oxide	250 mm (9.84 inch)
Other gases	240 mm (9.45 inch) (see 3.12)

Scale length 152 mm (6 in) minimum
(all flow tubes except carbon dioxide)

4.4 Gas Pressures

	USA/ Canada/Japan	UK
Pipeline supplies:	340 kPa (50 psig)	400 kPa (58 psig)
Cylinder supplies:		
Reduced pressure from regulator (at 5 L/min flow)	310 kPa +15 kPa / -35 kPa (45 psig +2 psig / -5 psig)	380 kPa +15 kPa / -35 kPa (55 psig +2 psig / -5 psig)
Regulator diaphragm bursting pressure	2800 kPa (406 psig)	2800 kPa (406 psig)
Reduced pressure system safety valve	600 kPa (87 psig)	600 kPa (87 psig)

Reduced pressure from secondary regulators (at 5 L/min flow)

Oxygen and Nitrous Oxide	152 - 241 kPa (22 - 35 psi)
Air	207 - 283 kPa (30 - 41 psi)
Machines built before March 2002:	
All gases	207 - 283 kPa (30 - 41 psi)

Safety valve 41 kPa ±10% (6 psi ±10%)
(to protect flowmeter, vaporizer etc.)

4.5 Auxiliary Gas Outlets

Pipeline supply: Gas is supplied at pipeline supply pressure (see above)
Cylinder supply: Gas is supplied at reduced pressure from cylinder regulator (see above)

Oxygen

Two self sealing connections on side frame upright
Total flow rate: not less than 100 L/min to free air
80 L/min against 243 kPa (36 psig) resistance
70 L/min against 270 kPa (40 psig) resistance
50 L/min against 297 kPa (44 psig) resistance

Air (on machines with Air supply option)

One self sealing connection on side frame upright.

SPECIFICATION

4.6 Oxygen Failure Warning Devices

1. Gas system whistle
2. Visual indicator, direct pressure operated

4.7 Oxygen Flush

Button on CGO block
The system supplies 35 - 75 L/min when fully depressed.

4.8 Mechanical AHD System

Minimum oxygen concentration 30% ±3% (of total O_2 + N_2O flow)

Basal Flow
Cascade flow tubes
Oxygen basal flow 50-75 ml/min

Single Flow tubes
Oxygen basal flow 100-200 ml/min

All models - up to March 2002:
Oxygen basal flow 100-200 ml/min

Reduced pressure from secondary regulators:
See section 4.4.

4.9 Environmental

Operating Conditions

Temperature	+10 to 38^{o}C (50 to 100^{o}F)
Atmospheric Pressure range	70 kPa to 106 kPa
Altitude	2438 m (8000 ft) maximum
Humidity	10 - 95% R.H. non-condensing.

Transport and storage temperature:

Basic machine	-5 to 60^{o}C (23 to 140^{o}F)
Oxygen monitor option	-5 to 50^{o}C (23 to 122^{o}F)

Cleaning Wipe external surfaces with dry or damp cloth.
Use mild soap, or disinfectant solution if necessary.

SPECIFICATION

MRI Compatibility

See additional notes in section 3.16.

The following Prima SP system components are MRI compatible:
Prima SP basic machine (includes any variant of Back Bar, Flowmeter Bank, Drawers, Monitor Shelves, Additional Gases)

A100 (In-board and pole-mounted) - see section 3.16.

A100SP Absorber
Caution - A100SP is normally fitted as part of an integrated system, comprising Prima SP and AV900 V4 ventilator - this system is not MRI compatible.

Nuffield 200 Ventilator

Delta Vaporizer

IDP Pressure Failure Alarm
(when secured to the machine, and used with appropriate batteries)

The following components are currently <u>not</u> MRI compatible:
Oxygen Monitor, Flowmeter lighting, Electrical power outlets, AV-series ventilator

4.10 Third and Fourth Gas Options

4.10.1 Air

Air flowmeter range: 1 - 10 L/min.
Cylinder yoke pin-indexed for medical air.
Pipeline inlet for air.
Cylinder pressure gauge.
Pipeline pressure gauge.
Air pipework is colour coded at each junction.

4.10.2 Carbon Dioxide

Carbon dioxide flowmeter range 20 - 500 ml/min (flow restricted to 500 ml/min).
Cylinder yoke pin-indexed for carbon dioxide.
Cylinder pressure gauge
Carbon dioxide pipework is colour coded at each junction.

4.11 Electrical Supply (if fitted)

Standard: 5.5 amp, 220-240 V, 50 Hz
Optional: 6 amp, 110-120 V, 60 Hz

Permanently attached 3 metre lead.
Stowage hooks for cable on rear.
Auxiliary electrical power outlets (if fitted):
SP102 4 outlets
SP101 3 outlets
Max. total current 5A

Battery back-up (oxygen monitor):
12 V, 1.8-1.9.9 AH, rechargeable sealed lead acid battery, provides a minimum of 60 minutes operation.

SPECIFICATION - *O_2 Monitor*

4.12 Oxygen Monitor

Measurement Range:	0 - l00%
Resolution:	±1%
Accuracy and Linearity:	±2% of full scale (at constant temperature and pressure)
Response Time:	90% of final value in approx. 10 seconds (air to 100% O_2)
Operating Temperature:	+10 to 38^{O}C (50 to 100^{O}F)
Storage Temperature:	-5°C to 50°C (23°F to 122°F)
Transport Temperature:	-5°C to 50°C (23°F to 122°F)
Relative Humidity Range:	5% to 95% (non-condensing)
Battery Back-up:	See section 4.11
Sensor Type:	MOX-3 galvanic fuel cell
High Priority Alarm:	Flashing, 5 audio pulses with 6 seconds repeat time.
Medium Priority Alarm:	Flashing, 3 audio pulses with 24 seconds repeat time
Low Priority Alarm:	Static with single beep sound
Alarm Mute:	30 seconds for high priority alarm 120 seconds for medium priority alarm
Low Alarm Set Range:	18%-99% (+/- 1%)
High Alarm Set Range:	19%-105% (+/- 1%)
Cable length:	2 m (6 ft), fully extended

Sensor

Type:	Galvanic fuel cell sensor (0 -100%)
Life:	1,500,000 O_2 percent hours at 20^{O}C (One year minimum in typical applications)

Interference Gases and Vapours (in 30% Oxygen, 70% Nitrous Oxide)

Interference	*Volume % Dry*	*Interference in O_2%*
Nitrous Oxide	*80%*	*<1%*
Carbon Dioxide	*5%*	*<1%*
Halothane	*5%*	*<1%*
Enflurane	*5%*	*<1%*
lsoflurane	*5%*	*<1%*
Sevoflurane	*5%*	*<1%*

Humidity Effects

Sensor output is relatively unaffected by prolonged operation in either high or very low relative humidity.

If the sensor shows signs of being affected by condensation, dry the sensor with soft tissue.

CAUTION *DO NOT use heat to dry the sensor.*

SPECIFICATION - *O_2 Monitor*

Oxygen Monitor - continued

Temperature Effects
The sensor has a built-in temperature compensation circuit, and is relatively unaffected by temperature changes within the operating temperature range given above.

Pressure Effects
The sensor measures O_2 partial pressure, and its output will rise and fall due to pressure change (e.g. changes in barometric pressure, or breathing system pressure).
An increase in pressure of 10% at the sensor inlet will produce a 10% increase in sensor output.

5. PRE-USE CHECKS

5.1 Pre-use Checklist

A pre-use checklist for the Prima SP range of machines is printed on the next page.
This checklist is also supplied with the machine.

Where necessary, subsequent sections in this manual provide an explanation and procedure for setting up the machine and ancillary equipment and the various checks that must be carried out before clinical use.

In addition, checks specific to non-AHD machines, and mechanical AHD machines are explained in separate sub-sections:

5.2 Non-AHD machines
5.3 Machines with mechanical AHD

Details of checks common to ALL types of machine (e.g. Check correct connection and functioning of vaporizers) are explained in sections 5.4 onwards.

WARNING
Pre-use checks must be performed before each period of clinical use.
These checks must be supplemented by periodic Function Testing, and full Service Testing by a Penlon-trained engineer to the Service Schedule given in the Prima SP Service Manual.

These checks will not in themselves ensure the safe use of the apparatus, which remains the responsibility of the qualified practitioner in charge of it.

PRE-USE CHECKS

PRE-USE CHECKLIST

The machine must be carefully inspected and checked as follows.

An incorrectly functioning machine must be repaired by a suitably qualified person before use.

1. Check for visible damage, machine stability, and condition of gas supply hoses.
2. Check for labelling which may indicate status of machine, including faults or recent servicing.
3. Check correct connection of electrical supply.
4. Check correct connections of gas supplies.
5. Check adequate pipeline supply and back-up cylinder supply.
6. Switch on gas delivery switch, and note special operating system:
   Check functioning of flowmeters.
   Check function of Mechanical AHD (if fitted).
   Check function of Air/N_2O interlock switch (if fitted).
7. Check correct connection and functioning of the vaporizers.
8. Check functioning of oxygen flush.
9. Check leak rate of low pressure gas system.
10. Check the integrity of the patient circuit.
11. Test the alarm system.

Refer to Section 5 in the User Manual for further information.

Ancillary equipment

12. Check operation of the AGSS.
13. Check functioning of ventilator, including disconnect alarm.
14. Check that the oxygen analyser and other patient monitoring equipment functions correctly.

Refer to the relevant user manual for further information.

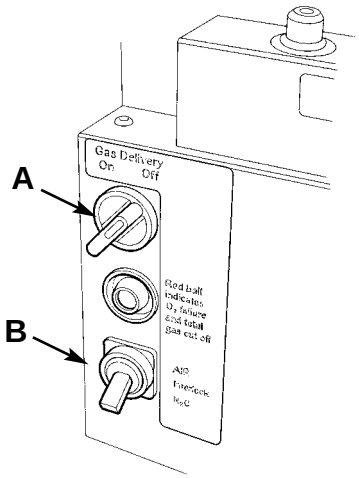
PRE-USE CHECKS - (Non-AHD Machines)

5.2 Pre-use Checks Gas Supply (Non-AHD)

5.2.1 Gas Pipeline Supplies

1. Connect the oxygen pipeline hose **only**.
   Check that the warning whistle sounds briefly as the hose is connected.
   Check that the correct pressure gauge reading is obtained.
2. Switch Gas Delivery Switch (A) to ON.
   On machines with Air, set the Air/N_2O interlock switch (B, if fitted) to N_2O (see 5.2.3).
   Open the oxygen and nitrous oxide flowmeter needle valves.
   Check that flow is only shown in the oxygen flowmeter.
3. Close the flowmeter valves.
4. Connect the other pipeline hoses in turn, and check the gauge reading for each gas.
   Check that gas flows when the relevant needle valve is operated.
   For Air, set the interlock switch (B, if fitted) to Air.

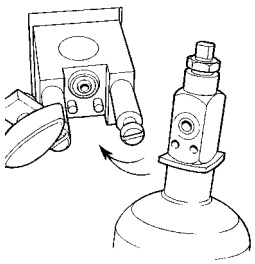
NOTE
If the machine is not equipped for connection to a pipeline supply, carry out the above procedures using the cylinder supplies.



5.2.2 Gas Cylinder Supplies

CAUTION
Open the cylinder valves slowly to avoid damage to the pressure reducing valve and pressure gauges. Ensure that valves are at least one full turn open when in use.

1. Fit the gas cylinders to their respective yokes, open the cylinder valves one at a time.
   Check the pressure on each cylinder gauge.



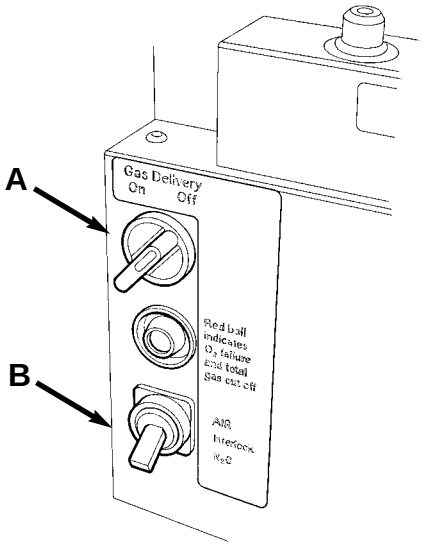
NOTE
A) When two cylinders are provided for a single gas, test each separately, clearing pressure after each test by opening the flowmeter valve.
B) Turn off the reserve cylinders during normal use.
C) N_2O - cylinder pressure does not indicate cylinder content.

2. Open the cylinder valve of the third and fourth gas cylinders (if fitted).
   Check the reading on the pressure gauge for each gas.
3. Ensure that all flowmeters are kept closed until gas supplies are required.

PRE-USE CHECKS - (Non-AHD Machines)

5.2.3 Flowmeters

1. Operate each flowmeter control knob in turn.
2. Check that full scale of flow can be achieved, and that the floats in all tubes move freely and rotate when at a steady flow.
3. On machines with Air and the optional Air/N_2O Interlock switch (B), use the switch to select air and nitrous oxide in turn
4. Check the supply of each gas.
5. Check that the flow can be turned off by gentle rotation of the control knob, and that the float reseats on the bottom stop.
6. On machines with optional dual cascade flow tubes, check that gas flow is through the low flow tube initially until full flow is achieved, then through the high flow tube.



5.2.4 Air/N_2O Interlock

NOTE: This is an additional option on machines with Air supply

1. Switch the Gas Delivery Switch (A) to ON.
2. Set the Air/N_2O Interlock switch (B) to Air.
3. Open the Air flowmeter control and check that Air is delivered.
4. Open the N_2O flowmeter control.
5. Check that N_2O is **NOT** delivered.
6 Set the Air/N_2O Interlock switch to N_2O.
7. Check that the flow of Air has stopped.
8. Check that N_2O is now delivered.

Continue Pre-use Checks at section 5.4

PRE-USE CHECKS - Machines with Mechanical AHD

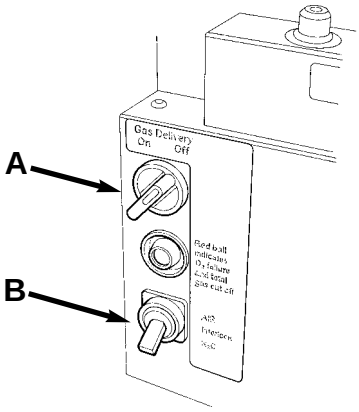
5.3 Pre-use Checks - Gas Supply (Machines with Mechanical AHD)

5.3.1 Gas Pipeline Supplies - Machines with Mechanical AHD

1. Connect the oxygen pipeline hose **only**.
   Check that the correct pressure gauge reading is obtained.
2. Turn on the Gas Delivery switch (A).
   Check that the warning whistle sounds briefly, and that the correct basal flow of oxygen is delivered (see section 4.8).
3. Open both oxygen and nitrous oxide flowmeter valves.
   NOTE: On machines with Air, and the optional Air/N_2O interlock system, set the switch (B) to N_2O (see section 5.3.4).
   Check that flow is only shown in the oxygen flowmeter.
4. Close both valves. Turn off the Gas Delivery switch.
   Check that the warning whistle sounds briefly, and that the oxygen basal flow is stopped.
5. Connect the other pipeline hoses, in turn.
   Check the gauge reading for those gases.
   Check that gas flows when the relevant needle valve is operated.
6. On machines with Air, and the optional Air/N_2O interlock system, set the switch (B) to Air (see section 5.3.4).

NOTE
If the machine is not equipped for connection to a pipeline supply, carry out the above procedures using the cylinder supplies.

CAUTION
On machines fitted with a mechanical AHD, the oxygen flowmeter control is restricted to prevent the needle valve from fully closing.
This ensures a minimum oxygen basal flow.
DO NOT attempt to close the flow to zero.
Do not overtighten the knob.

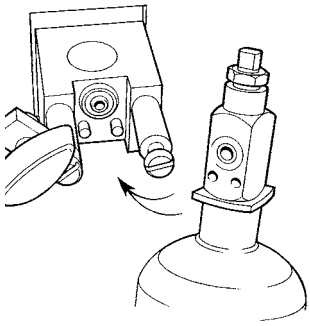


5.3.2 Gas Cylinder Supplies

CAUTION *Open the cylinder valves slowly to avoid damage to the pressure reducing valve and pressure gauges. Ensure that valves are at least one full turn open when in use.*

1. Fit the gas cylinders to their respective yokes, open the cylinder valves one at a time and check the pressure on each gauge.

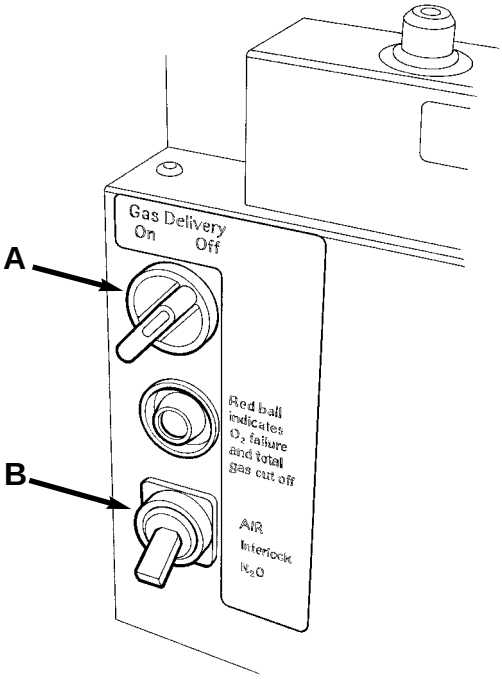
NOTE
A) When two cylinders are provided for a single gas, test each separately, clearing pressure after each test by opening the flowmeter valve.
B) Turn off the reserve cylinders during normal use.
C) N_2O - cylinder pressure does not indicate cylinder content.



2. Check the third and fourth gas cylinders (if fitted), open the cylinder valve and check the contents on the pressure gauge.
3. Ensure that all flowmeters are kept closed until gas supplies are required.

PRE-USE CHECKS - Machines with Mechanical AHD

5.3.3 Flowmeter - Machines with Mechanical AHD



1. Turn on the Gas Delivery switch (A) and check that the warning whistle sounds briefly, and that the correct basal flow of oxygen is delivered (see section 4.8).
2. On machines with Air, and the optional Air/N_2O interlock system, set the switch (B) to N_2O (see section 5.3.4).
3. Open the nitrous oxide needle valve and check that there is no nitrous oxide flow.
4. Operate the oxygen flowmeter needle valve.
   Check that full scale of flow of oxygen and nitrous oxide can be achieved, and that the floats in both tubes move freely and rotate when at a steady flow.
5. Check that the nitrous oxide flow can be turned off by gentle rotation of the oxygen knob.
   Check also that the nitrous oxide float reseats on the bottom stop, and that the oxygen basal flow continues to flow.
6. Operate the other control knobs in turn to check:
   the full scale of flow can be obtained;
   the floats move freely and rotate at a steady flow;
   the flow can be turned off by gentle rotation of the knob; and that
   the floats reseat on the bottom stop.
7. On machines with Air, and the optional Air/N_2O interlock system, set the switch (B) to Air, to check the supply for this gas.
8. On machines with optional dual cascade flow tubes, check that gas flow is through the low flow tube initially until full flow is achieved, then through the high flow tube.

5.3.4 Air/N_2O Interlock (machines with Air supply option)

1. Switch the Gas Delivery Switch (A) to ON.
2. Set the Air/N_2O Interlock switch (B) to Air.
3. Open the Air flowmeter control and check that Air is delivered.
4. Turn on the oxygen supply at the flowmeter.
5. Open the N_2O flowmeter control.
6. Check that N_2O is **NOT** delivered.
7 Set the Air/N_2O Interlock switch to N_2O.
8. Check that the flow of Air has stopped.
9. Check that N_2O is now delivered.

Continue Pre-use checks at section 5.4

PRE-USE CHECKS - All models

5.4 Leak Rate Check - Low Pressure Gas System

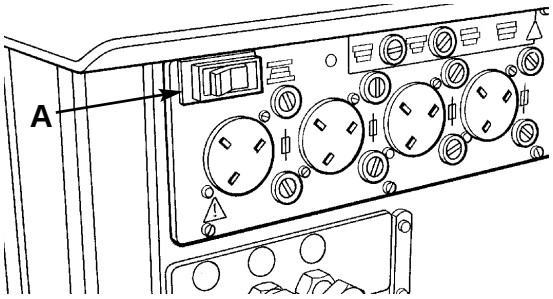
1. Attach a side branch connector to the fresh gas outlet on the CGO block outlet.
   Connect the side branch tube to a sphygmomanometer.
2. Turn on a flow of 150 ml/min of oxygen. Block the open port of the connector with a finger.
   The pressure in the low pressure gas system will rise and be displayed on the sphygmomanometer.
3. Check that the pressure rises to at least 100 mmHg.
   Release the finger seal immediately the pressure is reached.

CAUTION

Do not maintain closure of the open port longer than necessary to perform the test.

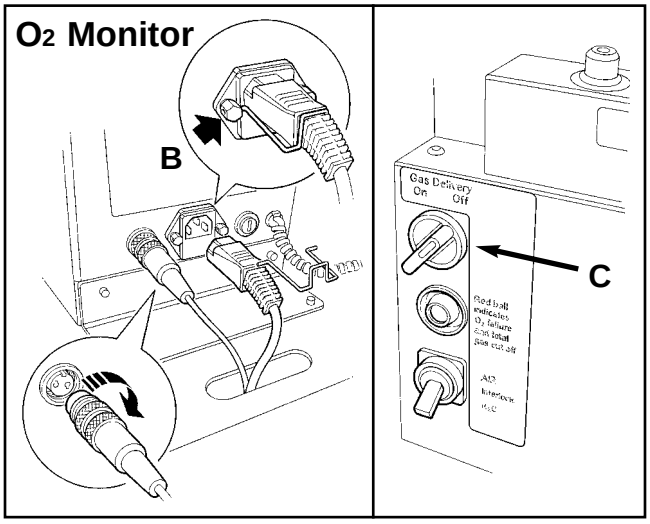
This test should be performed:
(a) With all vaporizers 'off' and isolated.
(b) With each vaporizer in turn set to 1%.

If an optional CGO switch is fitted (see section 3.9), the lever must be set to the vertical position.



5.5 Electrical Supply (if fitted)

1. Connect the machine power lead to a suitable mains supply socket.
2. Set the switch (A) to ON.
   Check for correct function of all electrical equipment, including devices powered by the auxiliary power outlets on the rear of the machine.
3. Machines with optional O_2 Monitor:
   Check for correct fitment of the mains lead (B) into the rear of the monitor unit.
   Switch the Gas Delivery Switch (C) to ON.
   Check that the monitor control panel LEDs activate.
4. Machines with optional flowmeter lighting:
   Check for correct operation.



PRE-USE CHECKS - All models

5.6 Patient Breathing System

5.6.1 Hose Connections

Check that all hoses are correctly connected, as illustrated:

5.6.2 A100 / A100SP Absorber

Always follow the pre-use check procedures given in the instruction manual supplied with the absorber.
The use of an oxygen monitor (and a carbon dioxide analyser) is highly recommended when using any partial rebreathing anaesthetic system.

5.6.3 Breathing System Hose, Reservoir Bag, Ventilator

Refer to illustrations on next page
Connectors for the Inspiratory hose (A) and Expiratory hose (B), and the reservoir bag connector (C) are 22 mm male.
All connectors comply with ISO 5356/1.

The ventilator connection point (D) is also 22 mm male.

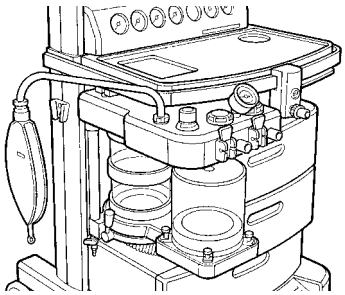
Hose and bag connections are fitted with Penlon Safelock high security fittings.

Check all connections for gas tightness.

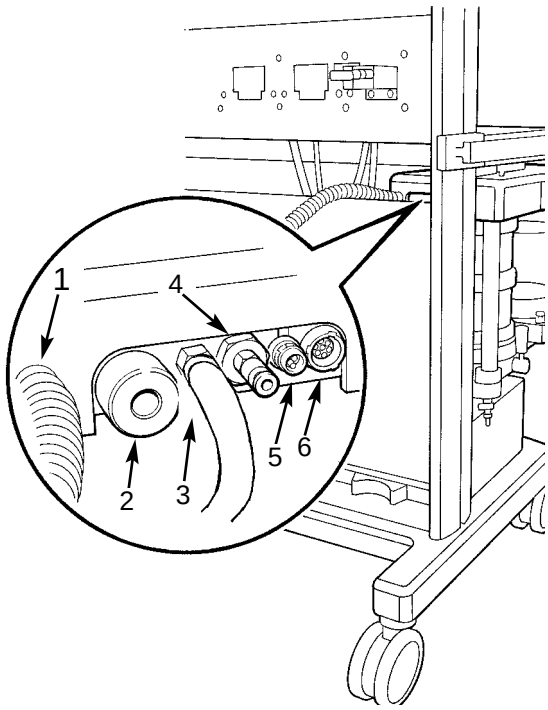
5.6.4 Fresh Gas Supply

Refer to illustrations on next page
The fresh gas hose assembly (E) supplied with the machine has a Penlon connector at the absorber inlet and a 22 mm Safelock taper at the other end.
This should be connected to the common gas outlet (F) of the anaesthetic machine.

Check all connections for gas tightness.



Prima SP with A100SP Absorber
For additional information, refer to Appendix 4.



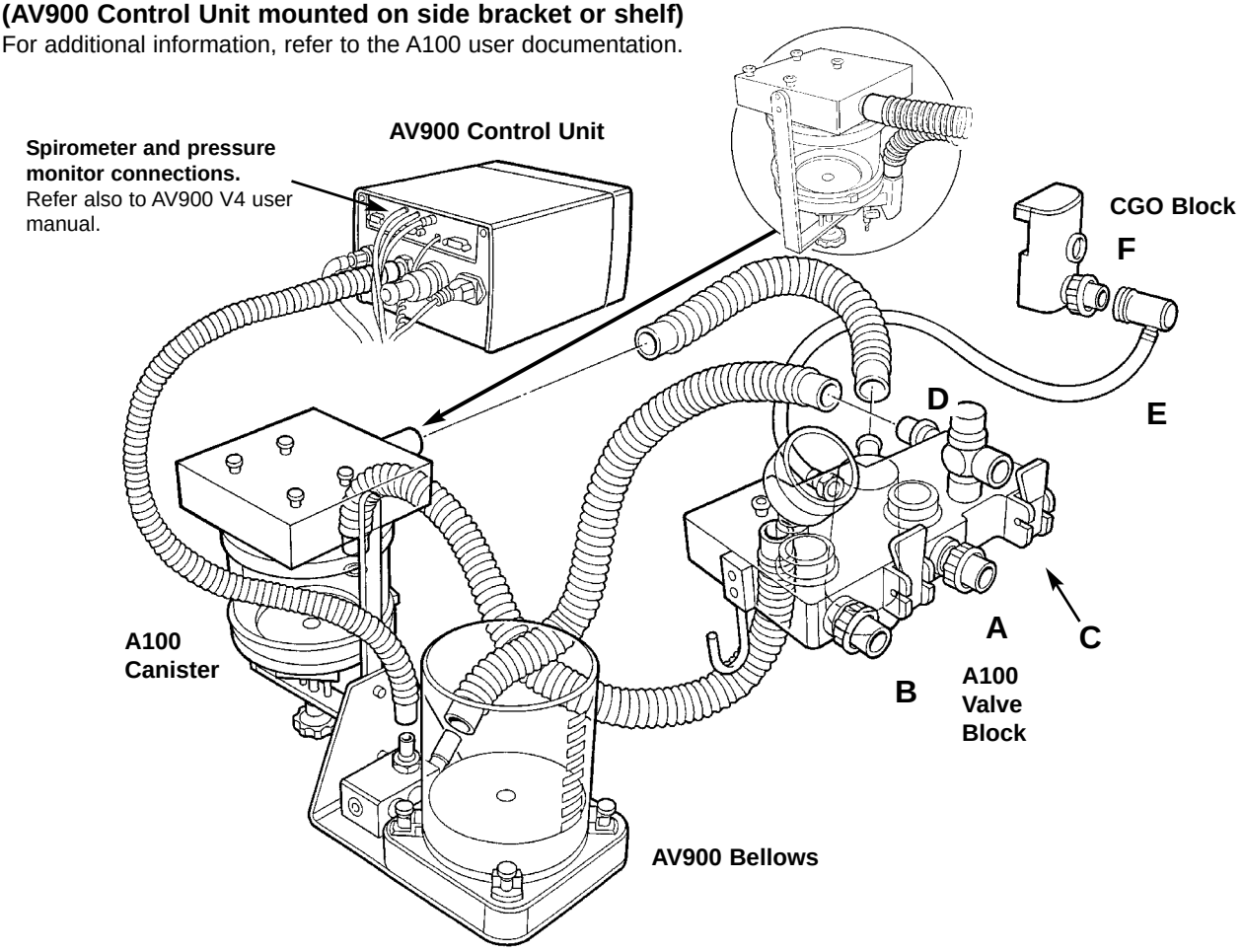
A100SP / AV900 V4 connections

1. Inlet - from DRIVE GAS outlet on AV900 control unit.
2. Exhaust outlet from APL Valve - connect to Anaesthetic Gas Scavenge System
3. Inlet - fresh gas hose from anaesthetic machine Common Gas Outlet
4. Outlet - sample line to Pressure Monitor Port on ventilator
5. Interface cable - Bag/Vent switch (connects internally to Prima SP On/Off Switch interface, then to connector on AV900 rear panel).
6. Spirometer signal cable - connected to socket on AV900 V4 rear panel.

In-board A100 Absorber and AV900 Ventilator Bellows

(AV900 Control Unit mounted on side bracket or shelf)

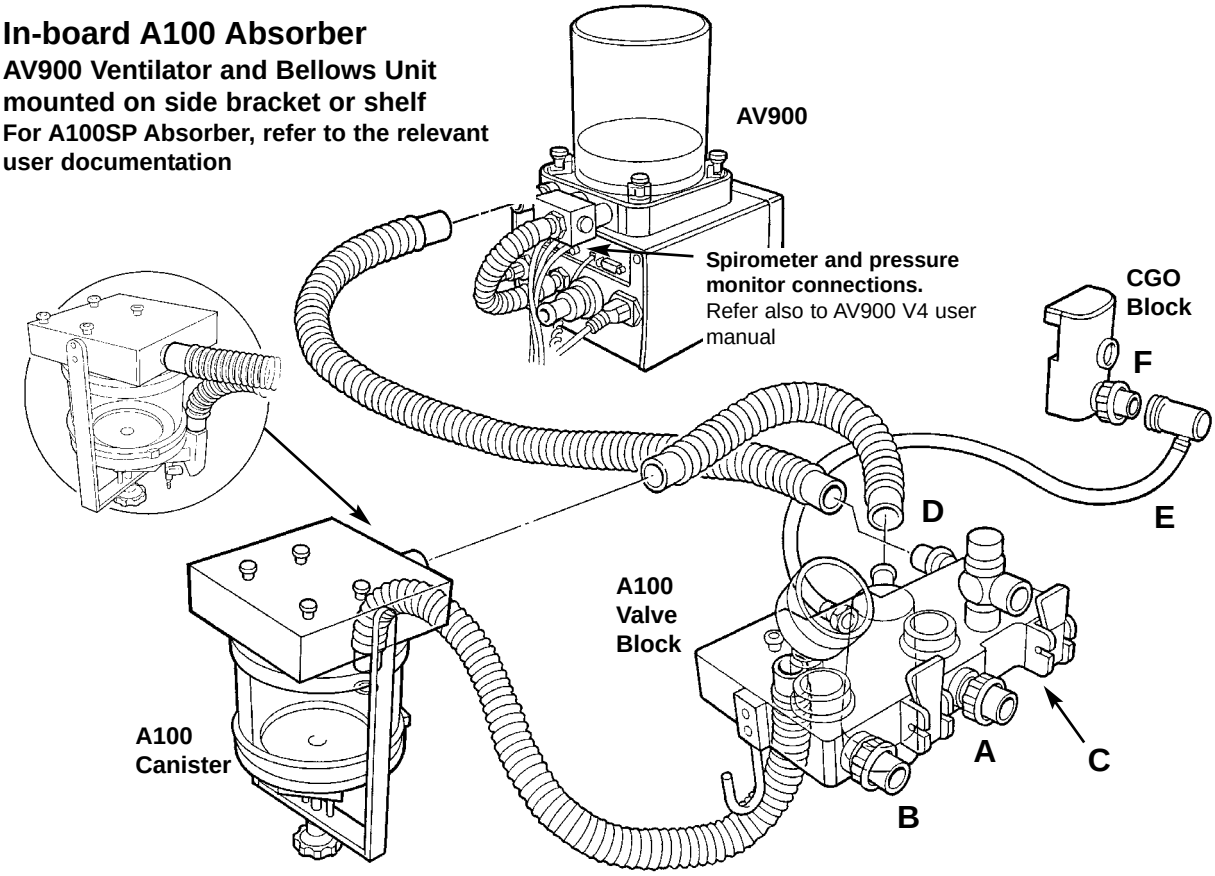
For additional information, refer to the A100 user documentation.



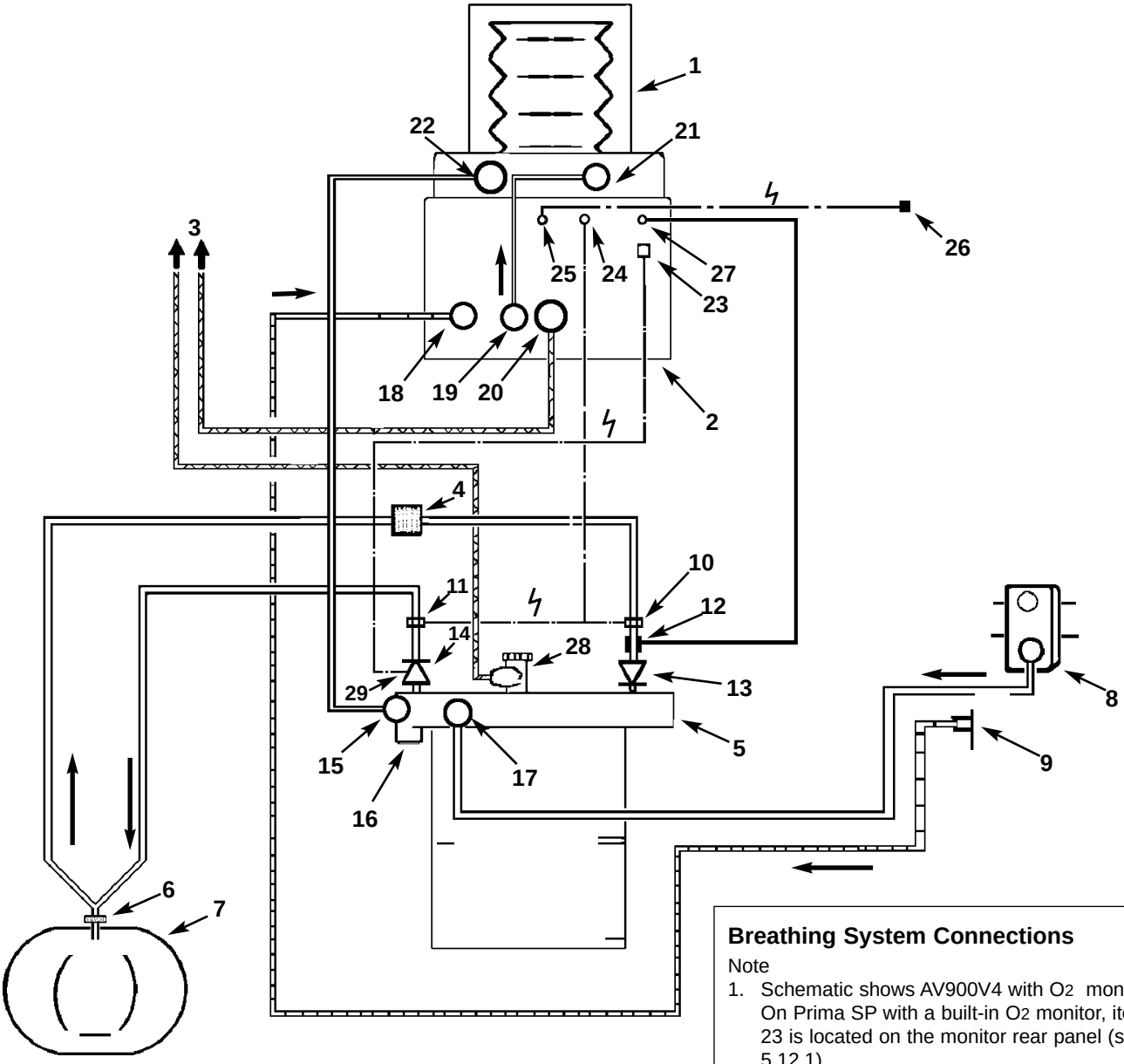
In-board A100 Absorber

AV900 Ventilator and Bellows Unit mounted on side bracket or shelf

For A100SP Absorber, refer to the relevant user documentation



PRE-USE CHECKS - All models



Breathing System Connections

Note

1. Schematic shows AV900V4 with O_2 monitor. On Prima SP with a built-in O_2 monitor, item 23 is located on the monitor rear panel (see 5.12.1).
2. Prima SP interface cabling is shown.
3. The absorber is fitted with a Bag/Vent switch.

1. Bellows
2. Control Unit
3. Outlets to Anaesthetic Gas Scavenging System (AGSS)
4. Bacterial Filter
5. Absorber valve block
6. Heat and moisture exchanger
7. Patient
8. CGO Block on anaesthetic machine (Fresh Gas Supply)
9. Auxiliary Outlet on anaesthetic machine (Drive Gas Supply)
10. Flow sensor - expiratory
11. Flow sensor - inspiratory
12 Sensor - pressure monitor
13. Expiratory Valve - Absorber
14. Inspiratory Valve - Absorber
15. Inlet - from Ventilator
16. Connector - Reservoir Bag
17. Inlet - Absorber - Fresh Gas Supply
18. Drive Gas Inlet - Ventilator
19. Drive gas Outlet - control unit to bellows
20. Outlet - Exhaust Valve
21. Inlet - Bellows Drive Gas
22. Outlet - to breathing system
23. Input socket - Oxygen monitor sensor
24. Input socket - spirometer
25. Input socket - Prima SP interface (SP on/off switch, and A100SP Absorber Bag/Vent lever position)
26. Interface connection on Prima SP (if fitted)
27. Connector - pressure monitor
28. APL Valve
29. Oxygen sensor (for alternative locations , see section 3.13.6)

5.6.5 Breathing Circuit Schematic

Note

1. *To protect the expiratory limb of the breathing circuit, and the spirometer, use a breathing circuit bacterial filter (4), or a heat and moisture exchanger (6) at the patient Y-piece.*

   CAUTION
   Replacement/Disposal - always follow the instructions supplied with the filter or heat and moisture exchanger.
   Always renew components at the recommended interval.

2. *Follow the instructions in the relevant user manual for connection to analysers and monitors.*

3. *Ventilator connections shown are for AV900 V4 with spirometry and oxygen monitor.*
   For AV900 V.3 and AV800 ventilators, please refer to section 5 in the relevant user manual.

4. *For A100SP, refer also to the user documentation supplied with the absorber.*

5.6.6 Breathing System Pre-use Test

Connect the CGO block outlet on the machine to the fresh gas inlet of the breathing system.
If an optional CGO switch is fitted (see section 3.9), the lever must be set to the vertical position.

NOTE
This machine must be fitted with a breathing system complying with approved design parameters, at the selection of the qualified practitioner.

The breathing system components do not constitute part of the machine but connections between the machine and breathing system should be verified as follows:

1. Occlude the adjustable pressure limiting (APL) valve (if fitted), and the patient connection port .
   Press the oxygen flush valve button briefly.
   Check that the reservoir bag inflates.
   If the system includes a manometer, inflate the bag to approximately 40 cmH_2O.

2. Release the oxygen flush valve.
   Check that the pressure is maintained in the system with less than 200 ml/min fresh gas delivered into the breathing system, showing that no leaks are present.

PRE-USE CHECKS

5.7 Oxygen Flush

Check for a high flow of oxygen through the CGO outlet when the flush valve button is pressed and that the flow ceases when the button is released.

NOTE
If an optional CGO switch is fitted (see section 3.9), the lever must be set to the vertical position.

This test is most conveniently done after the breathing system has been attached, using the reservoir bag as an indicator of gas flow.

5.8 Anaesthetic Gas Scavenge System (AGSS)

By inspection, check that all sources of expired anaesthetic gases, e.g. the absorber APL valve, and the ventilator bellows patient gas exhaust port, are connected to an approved collection system leading to an AGSS.

WARNING
Vacuum systems must not be connected directly to the APL valve on the absorber. A receiving system with a positive and negative pressure control function must be interposed. Systems must comply with standard ISO 8835 part 2.

PRE-USE CHECKS

5.9 Alarm System Test

WARNING
The anaesthetic machine must not be used if any alarm is not functioning correctly.

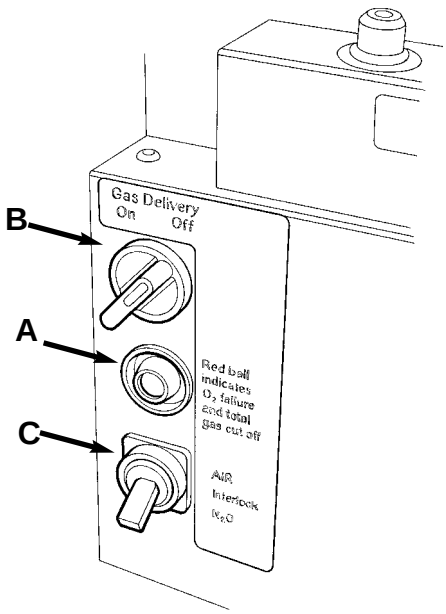
Primary Oxygen Failure Alarm

The machine is fitted with a warning whistle and a visual indicator (A).
These components act as oxygen supply failure devices and constitute the primary alarm system, powered only by the residual oxygen supply, as described in section 3.

The system can be checked whenever the low pressure oxygen system is first pressurised by turning on a cylinder or connecting a pipeline.

a) The whistle will sound briefly as pressure increases, and,

b) The visual indicator will turn from red to green.



Whistle, Visual Indicator, and Gas Cut-off Device Test

A formal test (including the action of the internal gas cut-off device) is performed as follows:

1. Connect both oxygen and nitrous oxide supplies.
2. Set the Gas Delivery switch (B) to ON, and check that the warning whistle sounds briefly.
3. On machines with Air, and an optional Air/N2O interlock system, set the switch (C) to N_2O.
4. Set a flow of 2 L/min on both flowmeters.
   (include CO_2, if this gas is provided).
5. Disconnect the oxygen supply at the wall socket or close the oxygen cylinder valve and check:
   a) that as the oxygen flow slows down, the whistle starts to sound and continues for at least 7 seconds.
   b) that the flow of nitrous oxide (and carbon dioxide if fitted) is cut off completely before the oxygen flowmeter shows zero flow.
   c) that the visual indicator (A) turns red before the oxygen flow is entirely stopped.
   NOTE All gases must be included in the pre-use check.
6. Reinstate the oxygen supply.
   Check that all gas flows are reinstated, and that the visual indicator turns green again.

Oxygen Monitor (if fitted)

See section 5.12.

PRE-USE CHECKS

5.10 Vaporizers

Always follow the procedures and checklist given in the instruction manual supplied with the vaporizer, particularly when filling the vaporizer with anaesthetic agent.

WARNING
Vaporizers must always be mounted, never used free-standing.
Free standing vaporizers may be accidentally tipped resulting in excessive and uncalibrated volumes of anaesthetic drug entering the breathing system.

Do not install or connect any vaporizer of any description between the CGO and the breathing system, unless it is specifically designed for such use. (This allows the oxygen flush flow to pass through the vaporizer, and severe overdosage may result).

5.10.1 Selectatec Mounting System

Dependent on choice of backbar manifold system, up to two Selectatec compatible vaporizers may be fitted.
To install the vaporizer, carefully offer the vaporizer up to the manifold.
Check that the gas connection ports on the vaporizer are aligned with the valves on the manifold.
Carefully lower the vaporizer onto the manifold and lock the vaporizer into position by clockwise rotation of the locking lever through 90^{o}.

NOTE Do not use excessive force to lock the vaporizer onto the manifold. Damage to the locking fastener will result.

CAUTION
To prevent damage to the locking shaft, ensure that the gas connection ports are aligned with the valves on the manifold, and are correctly engaged, before tightening the locking lever.

5.10.2 Selectatec Compatible Vaporizers with Interlock

WARNING
Only vaporizers with the Selectatec compatible interlock function will interlock if installed on a two station manifold.
The installation of non-interlock vaporizers allows the possible operation of more than one vaporizer at the same time.

Check that the interlock mechanisms of all the vaporizers on the manifold are working correctly, i.e. check that only one vaporizer at a time can be turned on.

5.10.3 Cagemount Vaporizer

Some international standards demand that this type of vaporizer should only be used on machines with a single mounting station.
In addition, use safety clip (Cat. No. 52275) to retain the cagemount taper cones in position on the vaporizer.

5.10.4 Pre-use Checks

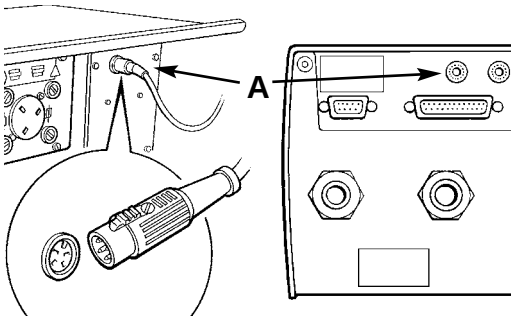
On ALL vaporizers, before use:
1. Check all joints for gas tightness.
2. Check vaporizer agent level.
3. Check for correct agent delivery concentrations - use an agent analyser.

Always follow the pre-use check procedures given in the vaporizer instruction manual.

5.11 Ventilator (if fitted)

Always follow the pre-use check procedures given in the ventilator instruction manual.
Check all hose and tubing connections for gas tightness.
Check all wiring connections for correct fitment and security.

AV900 V4 Ventilator
Check for correct fitment of the interface cable at each connector (A).



Check the interface system function:
a) Turn the Gas Delivery Switch ON. The ventilator will power-up.
b) While the Prima SP power is ON, the AV900 V4 can be turned off and on, using the ventilator On/Off switch.
c) Turn the Gas Delivery Switch to OFF. The ventilator will power-down.

PRE-USE CHECKS - Oxygen Monitor

5.12 Oxygen Monitor

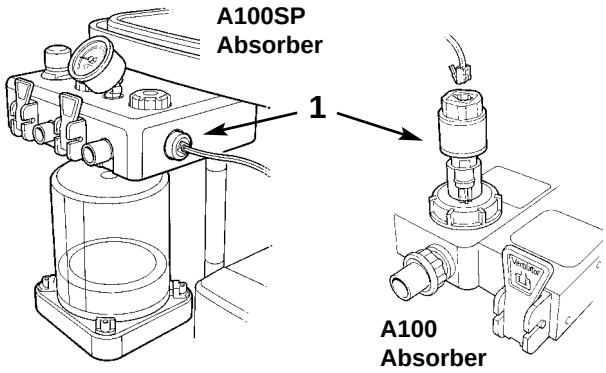
The pre-use checks for the oxygen monitor include a set-up and calibration procedure.

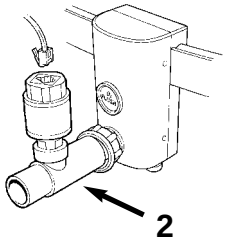
NOTE
Prima SP with A100SP Absorber:
Please refer to Appendix 4, (Doc No A100SP 103DS(U), supplied with the absorber).

5.12.1 Sensor Location

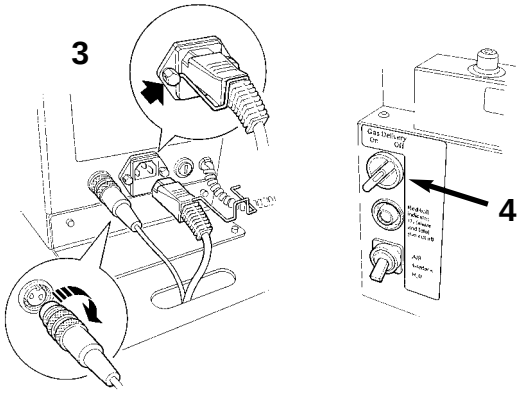
Check that the sensor (1) is correctly fitted, as illustrated, depending on the system installed on your anaesthetic machine

1. **Prima SP with A100SP Absorber**
2. **Mounted on the dome of the absorber inspiratory valve**
3. **'T' piece adaptor (2) on CGO block**
   a) using a 22 mm taper and Safelock nut, or
   b) using a 22 mm male/female tee fitting of suitable design.





Check that the cables and leads (3) are correctly fitted at the rear of the monitor control unit.
For AV900 V4 ventilator with built-in oxygen monitor, please refer to the ventilator user manual.



5.12.2 System Set-up

Switch on the oxygen monitor using the Gas Delivery switch (4) on the front panel.

NOTE
The Gas Delivery switch must be in the On position for gas delivery from the anaesthetic machine, and to supply electrical power to the oxygen monitor.

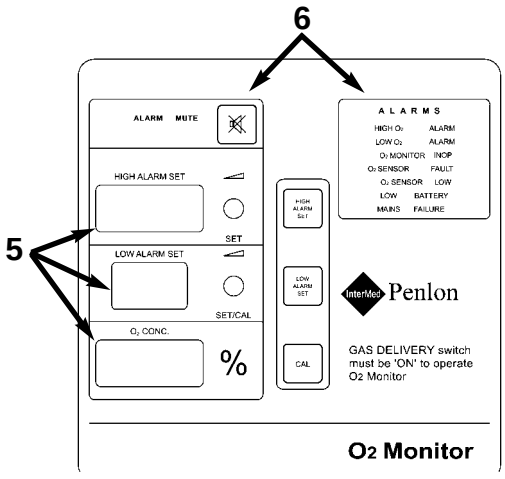
Check that the display LEDs (5) and the alarm indicators (6) are lit for two seconds, and that the audible alarm sounds.

5.12.3 Calibration

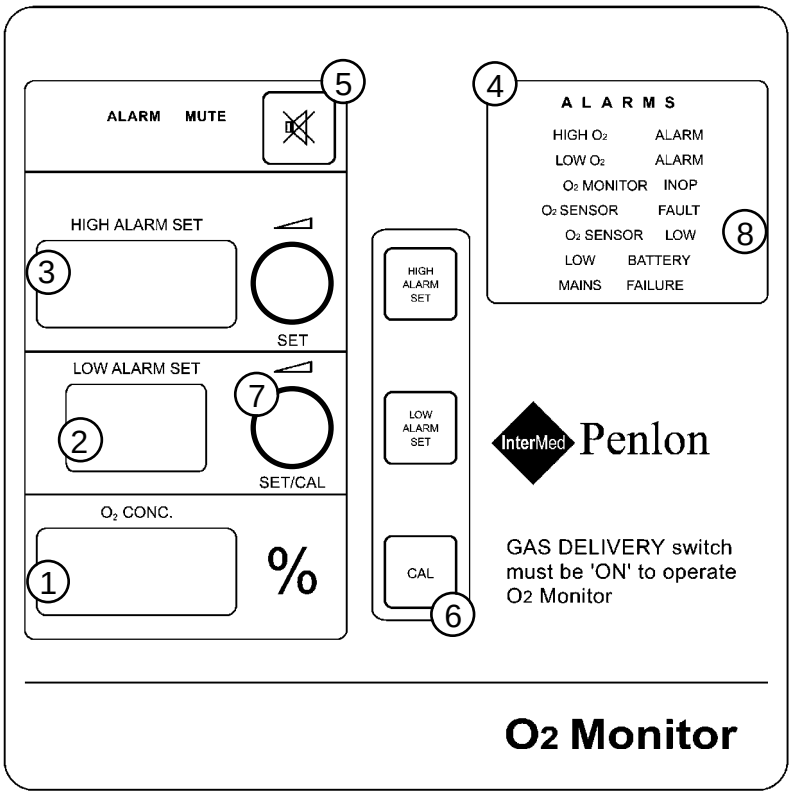
A new unit must be calibrated before clinical use. **Thereafter, we recommend calibration every time the system is switched on, as a safety precaution.**

Calibration must also be performed:
A) when the sensor is replaced, or
B) when point-of-use elevation changes by more than 160 m (500 ft).

We recommend calibration with a 100% oxygen standard source, at a pressure and flow similar to your application.
Calibration at lower concentrations or with room air is possible, but less desirable.



PRE-USE CHECKS - Oxygen Monitor



5.12.4 Calibration Procedure - Using 100% Oxygen

1. Switch on the oxygen monitor using the Gas Delivery switch on the machine front panel.
   The LEDs (1, 2, 3) and alarm visual indicators (4 and 5) will illuminate, and the audible alarm will sound.

2. Ensure the oxygen sensor is mounted correctly at the CGO hose connector - see section 5.12.1.
   All vaporizers must be OFF.

3. Flush 100% oxygen through the CGO and maintain the flow through the total breathing circuit for approximately 20 seconds.

4. Allow the oxygen reading to stabilise. This will take at least 30 seconds.

5. Press the CAL button (6) to enable sensor calibration mode.
   The O_2 CONC LED (1) will flash, and a single ‘beep’ warning will sound.

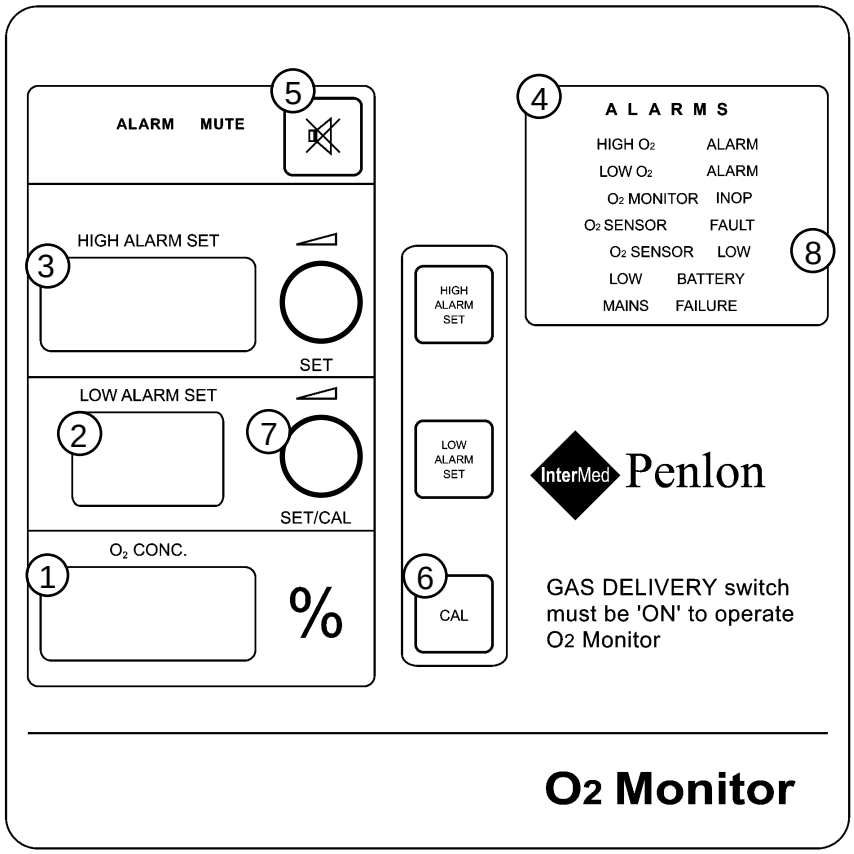
6. Turn the SET/CAL knob (7) until the display shows 100%.

7. When value is set, press the CAL button (6) again to accept the calibration setting.
   The O_2 concentration display LED (1) will now stop flashing (and a single ‘beep’ warning will sound),
   The display will return to normal operation.

Sensor Low Indication

The unit has a self detect feature to indicate when the sensor life is low.
During calibration, if the O_2 SENSOR LOW alarm LED (8) illuminates (and a single ‘beep’ warning sounds) this indicates that the sensor must be replaced.
Sensor output will fall very quickly to zero over a period of two to three weeks from the first time that the alarm is activated.

PRE-USE CHECKS - Oxygen Monitor



5.12.5 Calibration Procedure - Using Room Air

NOTE Calibration in room air may not provide as great an accuracy as calibration carried out in 100% oxygen.

1. Switch on the oxygen monitor using the Gas Delivery switch on the machine front panel.
   The LEDs (1, 2, 3) and alarm visual indicators (4 and 5) will illuminate, and the audible alarm will sound.

2. Remove the sensor from the anaesthetic machine, gently move it through the air to allow room air to circulate for 20 seconds.

3. Allow the O_2 Concentration reading (1) to stabilise.
   This will take at least 30 seconds.

4. Press the CAL button (6) to enable sensor calibration mode.
   The O_2 CONC LED (1) will flash, and a single 'beep' warning will sound.

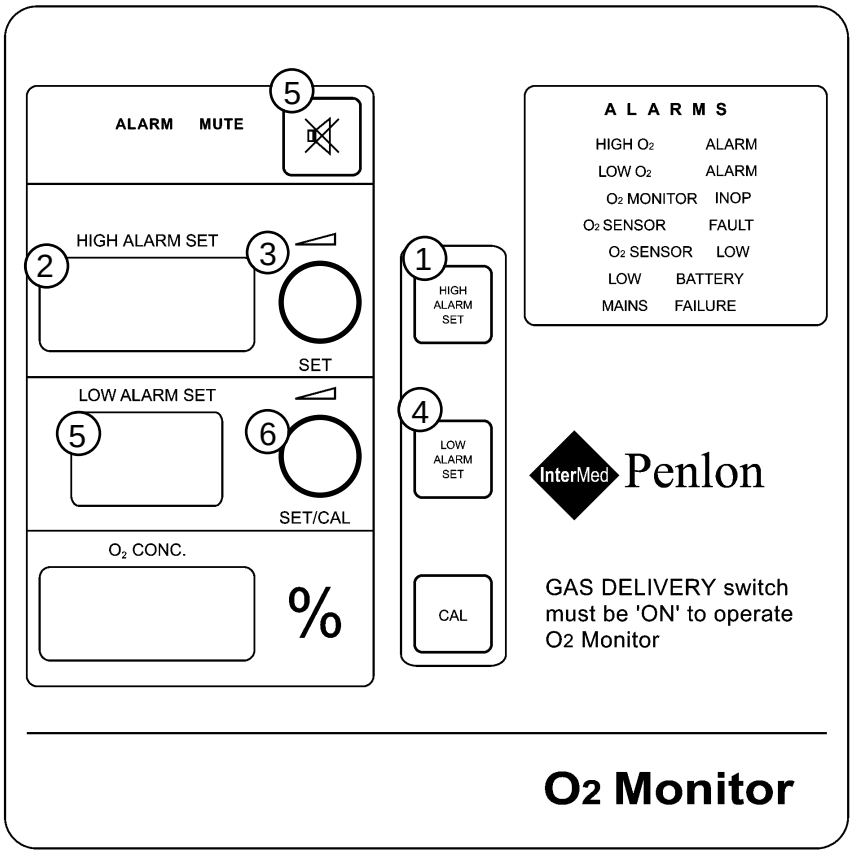
5. Turn the SET/CAL knob (7) until the display shows 21%.

6. When value is set, press the CAL button (6) again to accept calibration setting.
   The display LED (1) will now stop flashing and a single 'beep' warning will sound.
   The display will return to normal operation.

Sensor Low Indication

The unit has a self detect feature to indicate when the sensor life is low.
During calibration, if the O_2 SENSOR LOW alarm LED (8) illuminates (and a single 'beep' warning sounds) this indicates that the sensor must be replaced.
Sensor output will fall very quickly to zero over a period of two to three weeks from the first time that the alarm is activated.

PRE-USE CHECKS - Oxygen Monitor



5.12.6 Set Alarms

Set High Alarm

The high alarm value cannot be set below 19%, or above 105%.
(Note that in certain conditions of excess pressure, the readout may show a value above 100%.).

1. Press the HIGH ALARM SET button (1) to enable high alarm set mode. The HIGH ALARM LED (2) will flash, and a single ‘beep’ warning will sound.

2. Turn the adjacent ‘SET’ knob (3) to the desired setting.

3. Press HIGH ALARM SET button (1) again.
   The unit will then exit the high alarm set mode.
   The LED display (2) will now stop flashing, and a single ‘beep’ warning will sound.

Set Low Alarm

The low alarm value cannot be set lower than 18%, or above 99%.

1. Press the LOW ALARM SET button (4) to enable low alarm set mode. The LOW ALARM display (5) will flash, and a single ‘beep’ warning will sound.

2. Turn the adjacent SET/CAL knob (6) to desired setting.

3. Press LOW ALARM SET button (4) again.
   The unit will exit low alarm set mode. The LED display will now stop flashing, and a single ‘beep’ warning will sound.

6. FUNCTION TEST

6.1 Introduction

Every PrimaSP anaesthetic machine is tested thoroughly before leaving the factory, but it is essential to undertake a complete performance check as described in this section before the machine is first used clinically.
This can be done initially by a Penlon trained engineer as part of the commissioning of a new machine. Subsequently, this function testing should be repeated at regular intervals.

Full function testing should be carried out, at six month intervals, by a Penlon trained engineer or other persons certificated by Penlon Limited.
Procedures for machine servicing are described in subsequent sections in this Service Manual.

Read the procedure carefully before carrying out each test, noting references to machine specifications and equipment.
Perform these tests in sequence.

Mechanical AHD

Function tests specific to non-AHD, and Mechanical AHD systems are detailed separately. These sections have special page headings

Equipment Required

No complex test equipment is required for the series of tests described below.

Leak tests
Apply a Leak Test Spray or a diluted solution of soap in water to the suspect connector, (not on high pressure cylinders) and check for a stream of bubbles at the joint.

Flow rates
Check with a respirometer or other suitable flow measurement device.

Electrical circuits
Check with a multi-meter.

Pressure
Check with a manometer.

Safety Precautions

WARNING
Before commencing any test work ensure that all vaporizers are in the "Off" position.
Note that the OFF position may be indicated on the vaporizer as a 0 (zero). Refer to the vaporizer instruction manual.

WARNING
During any test procedure the release of Nitrous Oxide or anaesthetic vapours into the working environment must be controlled.
Connect the machine to an approved anaesthetic gas scavenging system (AGSS).

WARNING
Do not contaminate pipeline connections, cylinder yokes, regulators or pressure gauges with oil or grease, or any other flammable lubricant or sealant.

FUNCTION TEST

6.2 Machine Frame

1. Check the main structure of the machine is firmly assembled, free from obvious distortion and damage and that all attachments are secure.

2. Check that the castor wheels are securely attached to the machine frame and that the wheels run and swivel freely. Check that the wheel locking mechanism is working.

3. Check the drawer unit(s) (where fitted) open and close smoothly.

4. Check that the writing tablet (if fitted) opens and closes smoothly.

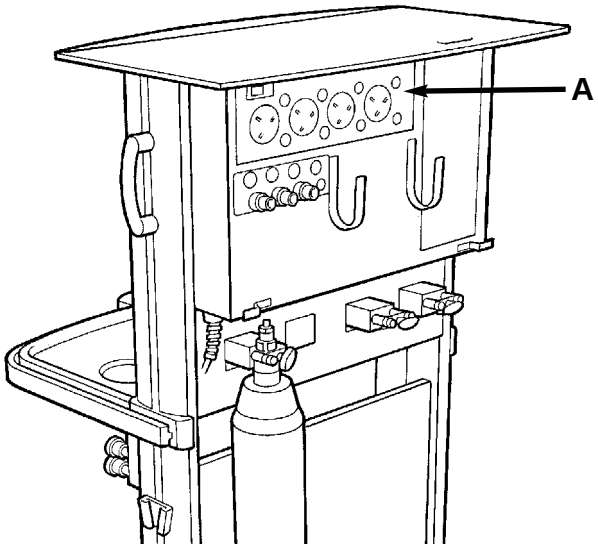
6.3 Electrical Safety Tests

1. Disconnect the mains lead from the electrical supply.

2. Disconnect all equipment from the auxiliary power outlet panel (A).

3. Perform Electrical Safety Tests as specified by the National Standards applicable to your country.

4. Check electrical outlet sockets for correct output and earth continuity.



FUNCTION TEST

6.4 Pipeline Gas Supply and Non-Return Valve

1. Ensure that all reserve gas cylinders are turned off, and removed from the machine.

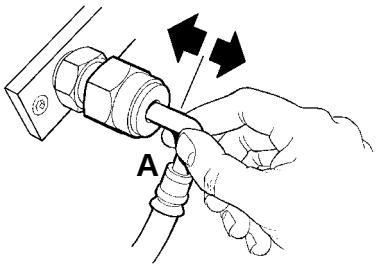
2. Leave the Gas Delivery ON/OFF switch in the "OFF" Position.

3. Check ALL Pipeline Hose assemblies for correct probes, colour coding, and attachment to the machine.

4. Inspect ALL Pipeline hoses for cracks, and check that all clips and connections are secure.

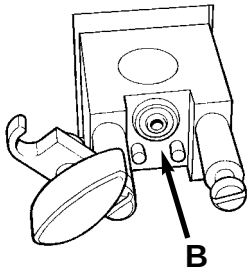
5. Connect the Oxygen Supply to the anaesthetic machine using the pipeline hose.

6. Check that the oxygen pipeline pressure gauge indicates the correct pipeline pressure.



7. Check the security of the Oxygen Hose connections by tug-testing the hose (A).
   Perform this test at both ends of the hose by tugging gently whilst grasping the hose between thumb and forefinger.
   Firm leak free joints should be maintained, without any relative movement of the spigot, ferrule or hose.
   Note: Renew all faulty hose assemblies.

8. Hoses:
   Test for leaks from each hose by brushing leak detecting fluid generously about both end fittings.



9. Pipeline Non-return Valve (NRV)
   Test for leaks, using a pipeline non-return valve or ball valve assembly.
   The leak rate should be less than 10 kPa in one minute.
   Alternatively, fit a tube securely to cover the hole in the centre of the Oxygen Cylinder Yoke Seal (B).
   Brush leak detecting fluid over the other end of the tube.
   Leaks will be indicated by bubbling of the fluid.

10 Dry with paper towel, fix any leaks (replace hose/NRV if necessary).

11. Connect the Nitrous Oxide Supply to the anaesthetic machine using the pipeline hose.
    Repeat tests 5, to 10 for this gas.

12. Connect the Air Supply to the anaesthetic machine using the pipeline hose.
    Repeat tests 5 to 10 for this gas.

FUNCTION TEST

6.5 Cylinder Gas Supply And Pressure Reducing Valves.

CAUTION
This machine is fitted with an hypoxia guard known as a Mechanical Anti Hypoxic Device (MAHD).
This device prevents the delivery of hypoxic mixtures to the patient and must only be adjusted by a Penlon-trained Engineer or other persons certificated to do so by Penlon Limited.
Incorrect adjustment of the MAHD could result in the failure of this device and the loss of hypoxia protection.

The oxygen control is restricted to prevent the needle valve from fully closing. This ensures a minimum flow of oxygen at all times while the machine is switched on.

This small flow of oxygen is known as the Basal Flow.

DO NOT attempt to fully close the oxygen flow to zero.

DO NOT overtighten Flow Control knobs for the other gases as this will reduce the life of the needle valves.

1. Ensure that all flowmeter control valves are shut. Disconnect all the pipeline gas supplies.

2. Remove all gas cylinders.

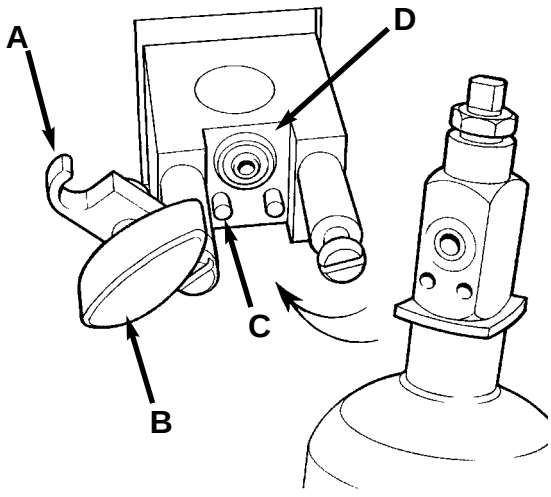
3. Check each cylinder yoke for security of attachment, and free movement of the clamp bar (A) and clamp screw (B).
   Check Pin Index system pins (C) are secure and undamaged.

4. Check that a seal (D) is in place and undamaged, in each cylinder yoke.

5. Attach each gas cylinder to its appropriate yoke, ensuring full engagement of the "Pin Index" system. Note: Use full bottles only.

6. Turn on the Oxygen Cylinder.
   Check that the Cylinder pressure is indicated on the Oxygen Cylinder pressure gauge in a smooth sweeping movement.
   Check that all other gauges indicate zero pressure.
   Check that there is no flow of gas indicated on the Oxygen flow tube.

7. Turn on the Gas Delivery Switch (E).
   Check that the warning whistle sounds briefly.
   Check that a basal flow of oxygen is delivered, as indicated in the table.



Basal Flow

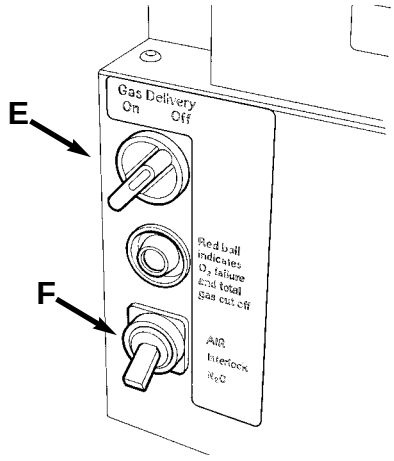
All models (up to March 2002)	100-200 ml/min
Cascade O_2 flowmeter (March 2002 onwards)	50-75 ml/min
Single O_2 flowmeter (March 2002 onwards)	100-200 ml/min

FUNCTION TEST

Leak Tests

For each Leak Test, allow a minimum 2 minute period.

8. Turn OFF Gas Delivery Switch (E).
9. Turn the Oxygen Cylinder OFF.
10. Drain down the oxygen system and blank off the output of the O2 secondary regulator. Turn on the O2 cylinder then turn off again.
11. Observe the pressure gauge reading; a leak will be indicated by the needle pointer falling towards zero.
    Maximum acceptable leak is 500 kPa.
12. Drain down the oxygen system and remove the blank. Reconnect the output of the secondary regulator.
13. Turn the Oxygen Cylinder ON.
14. Turn the Gas Delivery Switch (E) ON (warning whistle will sound briefly).
15. Check that all flow control valves are in the OFF position and that the only flow indicated is the Oxygen Basal Flow.
16. Switch the Nitrous Oxide / Air Control (F) to select Nitrous Oxide.
17. Turn the Nitrous Oxide Cylinder ON.
    Check that the Nitrous Oxide pressure gauge responds in a smooth sweeping movement
    Check that the only Gauges indicating pressure are those for Oxygen and Nitrous Oxide
    Check again that the only indicated flow is the Oxygen Basal Flow.
18. Turn the Nitrous Oxide Cylinder OFF.
19. Observe the pressure gauge reading; a leak will be indicated by the needle pointer falling towards zero.
    Maximum acceptable leak is 200 kPa.
20. Turn the Nitrous Oxide Cylinder ON.
21. Turn the Nitrous Oxide / Air Control Switch (F) to select Air.
22. Turn the Air Cylinder ON.
    Check that the Air pressure gauge responds in a smooth sweeping movement.
    Check that the only Gauges indicating pressure are those for Oxygen, Nitrous Oxide and Air.
    Check again that the only indicated flow is the Oxygen Basal Flow.
23. Turn the Air Cylinder OFF.
24. Observe the pressure gauge reading.

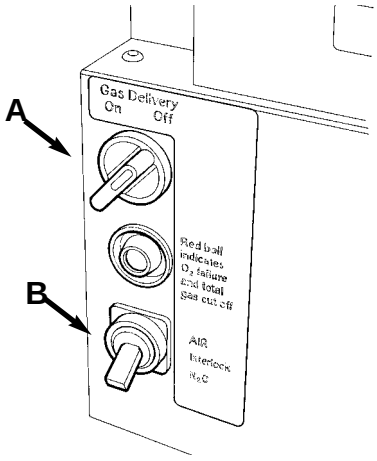


    A leak will be indicated by the needle pointer falling towards zero.
    Maximum acceptable leak is 500 kPa.

25. Turn the Air Cylinder ON.
26. If Carbon Dioxide (CO_2) Cylinder supply is fitted - turn CO_2 cylinder ON.
    Check that the CO_2 pressure gauge responds in a smooth sweeping movement.
    Check that ALL cylinder pressure gauges are indicating pressure.
    Check again that the only indicated flow is the Oxygen Basal Flow.
27. Turn the CO_2 cylinder OFF.
28. Observe the pressure gauge reading; a leak will be indicated by the needle pointer falling towards zero.
    Maximum acceptable leak is 200 kPa.
29. Turn the CO_2 Cylinder ON.
30. Set all gas flows, as required, to 5 litres/min (except CO_2, set this to 500 ml/min).
31. Connect a manometer to each Primary regulator test point in turn and check regulator is set in accordance with specification for relevant country.
32. Connect a manometer to each Secondary regulator test point in turn and check regulator is set in accordance with specification for relevant gas.
33. Reduce gas flows to minimum settings.

FUNCTION TEST

6.6 Flowmeter Unit, Nitrous Oxide / Air Selection Switch, Oxygen Fail Cut-off and Warning



1. Visually inspect the flowmeter tubes for damage.
   Check that the transparent shield is in place.

2. Turn the Gas Delivery Switch (A) to ON.
   Check that a basal flow of oxygen is delivered, as follows:

   All models (up to March 2002) 100-200 ml/min

   Cascade O_2 flowmeter (March 2002 onwards) 50-75 ml/min

   Single O_2 flowmeter (March 2002 onwards) 100-200 ml/min

3. Open the Oxygen Flowmeter control slowly.
   Check that a full flow can be obtained.

4. Set a flow rate of 6 L/min
   Check that the float is stable in its setting and spins freely.
   Repeat test at a flow rate of 500 ml/min.

5. Without rotating the control knob, check for wear by gently pulling on the knob, and check that any fluctuation in flow rate is within the range of ±100 ml/min.

6. Close the Oxygen Flowmeter control valve gently until the mechanical stop engages.

7. Check Oxygen Basal Flow (see operation 2).

8. **Nitrous Oxide / Oxygen Linkage**
   Switch the Nitrous Oxide / Air control (B) to select Nitrous Oxide

9. Fully open the Nitrous Oxide Flow control and check that **no** flow is indicated on the flow tube.

10. Slowly open the Oxygen Flowmeter control and check that the Nitrous Oxide flow tube float rises.
    Pause briefly at an indicated Nitrous Oxide flow of 4 L/min.
    Check that the Nitrous Oxide flow tube float is stable in its setting and spins freely.
    Increase the Oxygen flow until maximum flow of Nitrous Oxide has been achieved.

11. Close the Oxygen Flowmeter control valve gently.
    Pause briefly when Nitrous Oxide flow indicates 500 ml/min.
    Check the stability of the Nitrous Oxide float and that it spins freely.
    Decrease the Oxygen flow until the mechanical stop engages.

FUNCTION TEST

Check that as the Oxygen flow rate is reduced, so is the flow of Nitrous Oxide. Check again that the only flow indicated is the Oxygen Basal Flow.

12. Close the Nitrous Oxide Flowmeter control.

13. **Nitrous Oxide / Air Selection Switch (machines with Air supply fitted).**
Set the Nitrous Oxide / Air switch (B) to select Air.

14. Open the Air Flowmeter control slowly and see that a full flow can be obtained.

15. Set an Air flow of 5 L/min and check that the Air flow tube float is rotating and stable.

16. Close the Air Flowmeter control gently until no gas flows.

17. **Carbon Dioxide Supply (if fitted)**
Open the Carbon Dioxide flow control and check that the maximum flow rate available is 600 ml/min.

18. Check that the float is stable and that it spins within the glass flow tube.

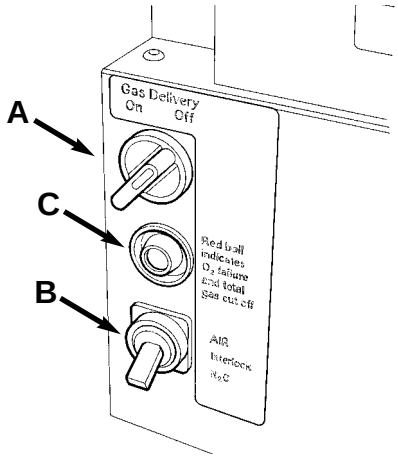
19. Close the Carbon Dioxide Flowmeter control gently until no gas flows.

20. Set the following flow rates:
Oxygen: 5 L/min
N_2O: 5 L/min
Air: 5 L/min.

21. Check that the only flows indicated are that of Oxygen and Air.
Check that the Nitrous Oxide flow tube indicates a flow of zero.

22. Set the Nitrous Oxide / Air switch (B) to select Nitrous Oxide.

23. Observe that the Air supply is cut off and that of Nitrous Oxide is reinstated.
Check that flow tubes now indicate flows of Oxygen and Nitrous Oxide, while the Air float has dropped to zero.



FUNCTION TEST

6.7 Gas Safety Devices - Mechanical AHD

1. Fully open the Nitrous Oxide Flowmeter and check that there is no flow of gas indicated on the N_2O flow tube.

2. Fit an Oxygen Analyser to the output of the Common Gas Outlet.
   Refer to the table below, and check % Oxygen concentration at the oxygen flows specified .
   Adjust the Oxygen Flowmeter control only - Do NOT adjust the N_2O flowmeter.
   Note The flow rates for N_2O are given as a guide only.

O2 Flow *(L/min)*	***%O2 (in O2/N2O mixture)***	*N2O Flow*
***0.25	27 - 33 %	0.5 - 0.67
***0.5	27 - 33 %	1.0 - 1.35
0.8	27 - 33 %	1.6 - 2.1
1.5	27 - 33 %	3.0 - 4.1
3.0	27 - 33 %	6.1 - 8.1

***Cascade flowmeter models - March 2002 onwards**

3. Turn OFF the Gas Delivery Switch.
   Check that both gas flows are stopped.

4. Turn ON the Gas Delivery Switch
   Check that both flows are reinstated.

5. Partially close the Nitrous Oxide flowmeter to check that it limits the Nitrous Oxide flow.
   Check that the reducing flow gives an increased Oxygen concentration.
   Fully open the Nitrous Oxide flowmeter.

6. Close the Oxygen flowmeter control valve gently until the mechanical stop engages.
   Check that the same corresponding values of Oxygen and Nitrous Oxide flows are achieved as tabled above.

7. Ensure that when the Oxygen flow is at its basal level, all Nitrous Oxide flows have ceased.
   Check that only the Oxygen Basal Flow is indicated on the flow tubes.
   Close the Nitrous Oxide Flowmeter and switch the Gas Delivery Switch to OFF.

Oxygen Fail Cut-off

8. Set the following flow rates:
   Oxygen: 5 L/min
   N_2O: 5 L/min
   CO_2 (if fitted) : 500 ml/min.

9. Turn Off the Oxygen Cylinder and observe that the Oxygen Cylinder pressure gauge indicates falling Oxygen pressure.

10. Check that the warning whistle (Oxygen Fail Alarm) sounds before the supply of oxygen is exhausted from the anaesthetic machine and that its duration is a minimum of 7 seconds.

11. Check that before the supply of Oxygen is exhausted from the anaesthetic machine, that Nitrous Oxide and Carbon Dioxide flows are cut off automatically by the Oxygen Fail System.

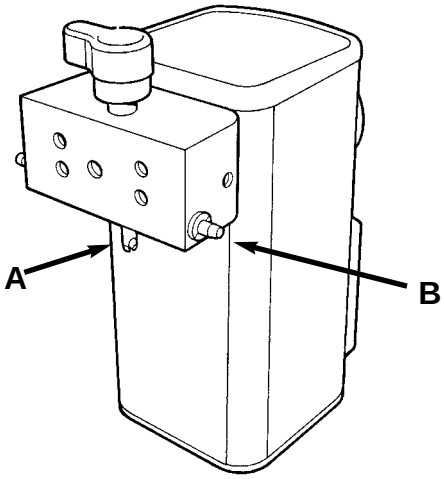
12. **Oxygen Fail Warning**
    Check that before the supply of Oxygen is fully exhausted, that the visual indicator (C) has turned fully red.

13. Turn OFF all Flowmeters and turn ON the Oxygen cylinder so that only the Oxygen Basal Flow is indicated.

14. Check that the visual indicator (C) is showing fully green.

FUNCTION TEST

6.8 Vaporizers and Back Bar Manifold Assembly



6.8.1 Selectatec Compatible Vaporizer

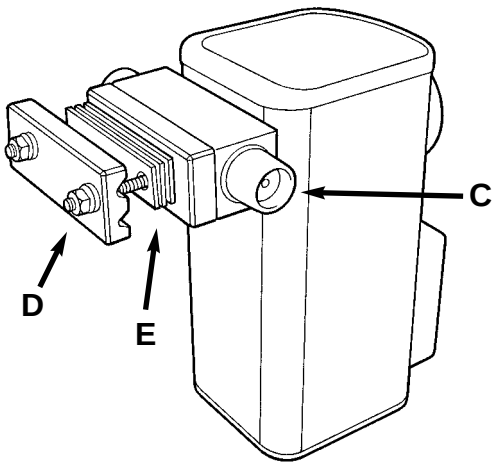
1. Check that all the vaporizers are securely mounted on the manifold.
   If a vaporizer is not secure, check the condition of the locking shaft (A).

2. On interlock vaporizers check that the interlock mechanism of each vaporizer is working correctly, i.e only one vaporizer at a time can be turned on.

3. Selectatec Manifold - check all pillar valves open and seal correctly. Check pillar valve inserts sit proud or flush with the pillar valve.
   A sunken pillar valve insert denotes failure of the internal spring.

6.8.2 Cagemount Vaporizer

Vaporizers fitted with the Cagemount tapers have the male taper (Inlet Port - C) on the left and the female taper on the right as viewed from the front of the vaporizer.
Two M6 studs with nuts, washers and a clamp plate (D) are provided to fix the vaporizer to the anaesthetic machine.



NOTE
Some international standards demand that this type of vaporizer should only be used on machines with a single mounting station.

In addition, use a safety clip (Catalogue No 52275) to retain the Cagemount taper cones in position on the vaporizer.

Fitting the Vaporizer

1. The taper cone joints must be engaged axially and not sideways loaded.
   Use the shims provided so that the distance from the back bar to the taper joint can be adjusted by adding or removing shims from the vaporizer.
2. The cone joints should then be lightly smeared with an Oxygen compatible lubricant such as "Fomblin".
   The taper joints must be engaged by applying axial pressure, and the fixing nuts tightened.
   Check all joints for gas tightness.
3. Check flexible hoses for security of attachment and integrity.

FUNCTION TEST

6.9 Reduced Pressure Gas Circuit Leakage. (Back Bar Leak Test and Pressure Relief Test)

1 Connect a suitable test pressure gauge (Manometer) to the Common Gas Outlet (CGO) using suitable tubing and connector.

2 Ensure all vaporizers attached to the machine are turned OFF.

3 Using the Oxygen Flow Control Valve, raise the pressure in the circuit slowly until a flow of 10 L/min is set.
Check that the Pressure Relief Valve (PRV) mounted under the gauge cover, on the right hand side, begins to leak in the range of 37 to 45 kPa.

4 Do not exceed this pressure.

5 Alter the pressure by reducing the Oxygen Flow Rate until the displayed reading on the test gauge is 20 kPa (150 mmHg).

6 The maximum permissible flow to maintain the above pressure is 200 ml/min.

7 If a higher flow rate is required to maintain a pressure of 20 kPa (150 mmHg) there is a leak in the system that must be fixed.
Use soap solution to detect leak, repair and repeat above tests (5, 6 & 7).

8 Repeat the above tests (5, 6 & 7) with all fitted vaporizers turned on (Test one at a time) to check gas tightness of each individual vaporizer.

A leaking vaporizer must be withdrawn from use.
Return the unit to Penlon (UK Customers) for repair, or arrange repair by a Penlon Approved Dealer (Non-UK Customers).

6.10 Emergency Oxygen Flush Control Test

1 Ensure all flowmeter control valves are turned off.

2 Oxygen Cylinder is turned on and Oxygen Pipeline is unconnected from the wall outlet.

3 Depress the Emergency Oxygen Flush (O2 Flush) button on the CGO block.

4 Check that the delivered flow rate is between 35 - 75 L/min.

5 Ensure the spring action cuts off the Oxygen flow when the button is released.

6. Check that the whistle does not sound when the Oxygen flush is operated.
If this occurs check that the Oxygen Cylinder Valve is fully open.
If the problem is not rectified, instruct the service engineer to check:
a) filters and Non-return valves for restriction.
b) the pressure of the primary Oxygen regulator.

7. Connect the oxygen pipeline and close the cylinder valve and repeat tests 3 - 6.

6.11 Auxiliary Outputs - Test

1 Check outputs for security and correct function.
2 With a suitable flowmeter measure the output from each outlet to ensure that greater than 100 litres/min can flow to free air.
3 Ensure that the oxygen failure alarm does not function during this test.
4. Repeat the test for both pipeline and cylinder supplies.

7. FAULT FINDING

7.1 Introduction

Provided the Prima SP Anaesthetic Machine is regularly serviced and correctly used, it is unlikely that serious component faults will occur.

After several years' usage, some items may require replacement and regular performance checks - see section 8.

To trace possible faults, refer to the Fault Diagnosis Table, which will indicate the required action.
In many cases, apparent machine faults may be attributable to causes other than machine malfunctions; these causes are also listed.

FAULT FINDING

7.2 Fault Diagnosis Table

Component	Symptom	Possible Fault	Remedy
Cylinder pressure reducing valves, gauges and yokes.	Leaking high pressure connection from cylinder to yoke.	Bodok seal absent or worn.	Fit/replace seal.
		Cylinder clamp screw assembly damaged.	Replace as necessary.
		Inadequate engagement of pin-index system.	Ensure correct gas cylinder is attached. Check index pins not loose or damaged. Replace as necessary.
Pressure relief valve leaks or out of adjustment.	Diaphragm or valve disc worn, damaged.	Adjust/replace regulator as necessary.	
		Faulty relief valve.	Fit new relief valve.
	Outlet pressure too high, - may occur with leaking pressure relief valve (above).	Diaphragm worn, damaged or out of adjustment.	Adjust/replace regulator as necessary.
		Regulator seat damaged.	Replace regulator.
	Outlet pressure too low.	Loose connections. Tighten leaking joints. (DO NOT use excessive force)	Test for leaks.
	Diaphragm or valve disc worn/damaged or regulator out of adjustment.	Adjust/replace regulator as necessary.	
	Pressure gauge reads zero when cylinder valve opened.	Cylinder empty.	Replace cylinder.
		Bodok seal absent or worn.	Fit/replace seal.
		Cylinder clamp screw assembly damaged.	Replace as necessary.
		Pressure gauge seal damaged.	Replace as necessary.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
		Inadequate engagement of pin-index system.	Ensure correct gas cylinder is attached. Check index pins not loose or damaged.
		Defective gauge.	Replace gauge.
	Pressure gauge pointer sticks at above zero reading.	Defective gauge.	Replace gauge.
		Gas trapped in system.	Open flowmeter and empty system.
	Leaking high pressure non-return valve.	Damaged ‘O’ seal.	Replace plunger ‘O’ seal assembly.
Pipeline supply hoses and inlet blocks	Pressure gauge reads zero when connection to supply made.	Loose connections. Tighten leaking joints. (DO NOT use excessive force).	Test for leaks.
		Defective gauge.	Replace gauge.
		Faulty probe or hose.	Replace as necessary.
		Blocked filter.	Replace as necessary.
		Pipeline supply defective.	Contact hospital engineer.
	Insufficient free flow.	Blocked filter.	Replace as necessary.
		Pipeline supply defective.	Contact hospital engineer.
Flowmeter units	Float stays at bottom of tube when control valve opened.	No gas supply.	Check cylinder/pipeline connections.
		Pressure reduction valve defect.	See instructions under component group
		Pipeline supply defective.	See instructions under component group.
		Control knob loose on shaft.	Tighten.
		Machines with Air supply - N_2O/Air Interlock switch correctly set.	Check position of switch.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Flowmeter units (Mechanical AHD only)	Float stays at bottom of tube when control valve opened(N_2O flowmeter)	Gas delivery switch left in off position.	Turn on gas delivery switch
		Gear linkage loose on O_2 or N_2O primary valve shaft.	Reset gears and tighten
	Restricted flow through flowmeter (Control valve opening does not achieve expected flow)	Gear linkage loose on valve shaft.	Reset gears and tighten
	Incorrect O_2 concentration.	N_2O flow limited by N_2O control valve.	Open N_2O control valve
		Secondary regulators out of alignment.	Check and reset secondary regulators. Replace if necessary
		Gear linkage loose on valve shaft.	Reset gears and tighten

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Flowmeter unit	Float sticks at above zero reading when control valve closed.	Dirt in tube.	Remove tube and clean.
		Build up of electrostatic charge.	Check earthing contacts at bottom of flowmeter tubes.
			Increase flow rate sharply to break charge, then close valve.
		Flowmeter unit not vertical.	Ensure trolley is on level surface.
		Upper float retaining peg not centralised or moulding flash not removed.	Remove flow tube and retaining peg. Clean off moulding flash and re-position retaining peg.
		Worn needle valve.	Replace complete valve and/or seat.assembly.
	Float level unstable after start up.	Pressure reducing valve defect.	See instruction under component group.
		Flowmeter unit not vertical.	Ensure machine is on level surface.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Flowmeter unit	Restricted flow through flowmeter (Control valve opening does not achieve expected flow).	Faulty cylinder pressure reducing valve, yoke or connections.	See instruction under component group.
		Faulty pipeline supply hoses or connections.	See instructions under component group.
		Blocked flowmeter filter.	Clean or replace lower bobbin assembly.
		Control knob loose on shaft.	Tighten.
		Incorrect valve restriction shimming.	Reset valve shims.
		Damaged valve seat assembly.	Replace complete valve.
	Float level falls after initial setting.	Reducing valve defect.	See instructions under relevant component group.
		Pipeline supply defect.	See instructions under component group.
		Leak in ‘upstream’ connection.	Test for leaks. Tighten leaking joints. (DO NOT use excessive force.)
		Blockage in ‘downstream’ gas circuit.	Trace site of blockage and clear.
		(Not oxygen flowmeter) Gas cut-off units in operation or defective.	See instructions under component group.
		Worn needle valve and/or seat.	Replace complete valve assembly.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Vaporizer mounting facility.	Leakage at back bar manifold or vaporizer interlock joints.	Loose manifold or vaporizer retaining screws.	Tighten.
		Missing ‘O’ seals	Replace ‘O’ seals.
Selectatec compatible system.	Leakage from back bar.	Damaged or worn gas valves.	Replace valve.
	Leakage from vaporizer connections. Vaporizer difficult to remove.	Damaged or worn ’O’ seals or seal faces.	Replace as necessary.
		Damaged or worn locking system.	Replace components as necessary.
N_2O and CO_2 gas cut-off unit.	No nitrous oxide, third or fourth gas.	Oxygen supply not turned on.	Turn on supply.
	No N_2O, third or fourth gas (or restricted flow of these gases)	Mechanical AHD gas delivery switch left in ‘Off’ position.	Turn on gas delivery switch
		Faulty safety capsule valve.	Replace valve.
	Safety capsule valve fails to operate correctly.	Valve shuttle or seals defective.	Fit replacement capsule valve.
		Loose valve retaining screws.	Tighten.
		Worn or damaged ‘O’ seals.	Replace seals.
		Vent port blocked.	See instructions under component group.
	Leaks at joint between manifold and valve seating.	Loose valve.	Tighten retaining screws
		Worn O seals.	Replace seals
	Valve cuts flow of nitrous oxide as required but does not restore it.	Valve shuttle or seals defective.	Fit replacement valve.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Warning Whistle.	Leakage at whistle.	Loose connection.	Tighten. (DO NOT use excessive force).
		Faulty whistle.	Replace whistle.
	Whistle continually sounds when oxygen on.	Faulty whistle.	Replace whistle.
		Low pressure in circuit.	See instructions under component group.
	Whistle fails to sound.	Faulty whistle.	Replace whistle.
		Low pressure in circuit.	See instructions under component group.
Pressure relief valve (fresh gas circuit)	Leakage through valve.	High pressure in circuit.	Reduce pressure. Check for blockage in 'downstream' circuit.
	Relief pressure too high.	Faulty valve	Replace complete valve
	Relief pressure too low.	Faulty valve	Replace complete valve.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Emergency oxygen flush	Valve does not operate.	No oxygen supply.	See instructions under component groups.
		Defective valve.	Replace valve.
	Low Oxygen flow (less than 35 l/min).	Low oxygen supply pressure.	See instructions under components group.
		Worn valve seals.	Fit new seals or replace valves as necessary.
		Incorrect adjustment of valve shaft.	Replace valve.
		Incorrect control jet.	Replace control jet.
	Leaks around control button.	Worn valve seals.	Fit new seals or replace valve as necessary.
	O_2 flow into breathing circuit or atmosphere (valve does not shut off flow).	Worn valve seals.	Replace valve.
		Incorrect adjustment of valve shaft.	Replace valve.
		Defective valve.	Replace valve.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Electrical power supply	Machine ‘dead’.	Mains supply /socket	Check supply (plug ON).
		Faulty on/off switch	Replace switch (front panel).
		Mains supply faulty.	Reset circuit breaker (rear panel).
Oxygen Monitor	Display blank when powered-up	Mains power off or faulty.	Check supply (plug/socket ON)
		Battery not charged.	Charge
		Faulty battery.	Replace battery
		Battery missing.	Fit Battery
	O_2 concentration display shows ‘E--’	Sensor not connected.	Check connections
	O_2 MONITOR INOP alarm is On		Press and hold both ALARM MUTE and LOW ALARM SET button. All the LEDs should illuminate for 2 seconds. The high alarm set and low alarm set will default to 100 and 18 respectively.
	Battery Low LED and Mains On LED illuminated.	Faulty battery.	Replace batteries.
		Faulty circuitry.	Replace control PCB or alarm PCB.
	Battery In Use LED illuminated (Mains supply connected)	Mains supply faulty.	A) Check supply (plug/socket, ON). B) Reset circuit breaker (rear panel).

8. SERVICE SCHEDULE

8.1 Service Schedule

Recommended Service Frequency

Six Month Service
Annual Service
Two Year Service
Six Year Service

NOTE: Preventive Maintenance Kit Part Numbers are listed in section 10.

8.2 Six Month Service Checks

(To be performed at 6, 18, 30, 42, 54, & 66 months of a 72-month cycle.)

Machine Frame:

1. Check integrity of structure and security of all attachments.
2. Check for damage.
3. Check wheels for freedom of movement, check front braking.
4. Check that drawers and writing tablet move freely.

Electrical Safety Test:

1. Check mains lead and plug for damage.
2. Perform Electrical Safety Tests as relevant for country of use.
3. Check output sockets for correct function.

Pipeline Hose Checks:

1. Examine pipeline connectors, probes and hoses for cleanliness and damage.
2. Perform anti-confusion checks.
3. Perform pressure Leak Checks of all hoses, with cylinders removed and Gas Delivery Switch in the OFF position.

Cylinder Yoke Assemblies:

1. Check for damage, cleanliness, all fittings are tight and clamping screws for freedom of movement.
2. Replace Bodok seals. DO NOT apply grease or lubricant

Pressure Gauge and Regulator Checks:

1. Examine all pressure gauges for damage and clarity.
2. Check movement of needles is smooth.
4. Perform pressure Leak Test of all cylinder Gas Supplies with all Pipelines disconnected from supply.
   Perform this test with Gas Delivery Switch turned ON and Oxygen Basal Flow blanked off.
5. For Air / N_20 repeat the test with the selector switch in the required position.
6. On completion of tests reinstate basal flow by removing test blanking plug.
2. Check output pressure of Primary Regulators.
3. Check output pressure of Secondary Regulators.

Flowmeter and Mechanical AHD Checks:

1. Check Flow Control Valves for smooth operation and positive off position.
2. Turn On Gas Delivery Switch
   Check Basal Flow of Oxygen is delivered with all Flow Control Valves closed down.

All models - up to March 2002	100-200 ml/min
Cascade O_2 flowmeter- March 2002 onwards	50-75 ml/min
Single O_2 flowmeter - March 2002 onwards	100-200 ml/min

SERVICE SCHEDULE

3. Check flow tubes.
4. Check Bobbin Floats move freely and rotate within the glass tube.
5. Check maximum flow capability of all gases.
6. If CO_2 is fitted check that the maximum flow is restricted to 500-600 ml/min flow rate.
7. Connect O_2 Monitor to CGO.
8. Check no other gas flows are indicated.
9. Ensure N_2O / Air Selection switch is positioned for N_2O.
10. Fully open N_2O Flow Control Valve
    Check that NO flow of N_2O occurs.
11. Slowly operate O_2 control valve throughout range and check that N_2O now flows
12. Operate N_2O/Air selector switch to Air position and check that N_2O ceases to flow and that Air is now available.
13. Return switch to the N_2O position and set the oxygen flow back to minimum.

14. Refer to the table below. Check % O2 concentration at the oxygen flows specified.
    Adjust the O2 Flowmeter control only - Do NOT adjust the N_2O flowmeter.
    Note The flow rates for N_2O are given as a guide only.

O_2 Flow	*%O_2 (in O_2/N_2O mixture)*	*N_2O Flow*
***0.25 L/min	27 - 33 %	0.5 - 0.67
***0.5 L/min	27 - 33 %	1.0 - 1.35
0.8 L/min	27 - 33 %	1.6 - 2.1
1.5 L/min	27 - 33 %	3.0 - 4.1
3.0 L/min	27 - 33 %	6.1 - 8.1

**Cascade flowmeter models - March 2002 onwards*

15. Repeat tests by reducing Oxygen flow back to Basal Flow conditions, referring to the values in the above table.
16. Check Gas Delivery Switch for correct operation.

Oxygen Fail Alarms:

1. Simulate an Oxygen fail by unplugging the Oxygen Pipeline from the outlet.
   Check that before the supply of oxygen is exhausted that the Oxygen Fail Whistle sounds for a minimum of 7 seconds.
   Check that any Nitrous Oxide and Carbon Dioxide (if fitted) Gas Flows are cut off.
2. Check that the Oxygen Supply Visual Indicator turns from fully green to fully red.
3. Turn on Oxygen cylinder.
   Check Oxygen Basal flow reinstated and whistle sounds briefly.
4. Turn off Oxygen cylinder and repeat above tests.

Back Bar Assembly - Selectatec - Checks.

1. Replace Selectatec O-rings. DO NOT apply grease or lubricant
2. Check all pillar valves open and seal correctly.
3. Check pillar valve inserts sit proud or flush with the pillar valve.
   A sunken pillar valve insert denotes failure of the internal spring.
4. Check vaporizer interlock system for correct operation.

Back Bar Assembly - Cagemount - Checks.

1. Check flexible hoses.
2. Check security of taper connectors
   Use Fomblin or other Oxygen-safe grease to lightly lubricate the metal surface where male and female connector come into contact with each other.

SERVICE SCHEDULE

Fresh Gas Pressure Relief Valve (PRV) Test.

1. Occlude CGO with a manometer.
2. At 10 L/min flow rate of Oxygen the PRV relieves at 41 kPa ± 10 %

Leak Test From Flowmeter to Common Gas Outlet

1. Fit a suitable Manometer Test gauge to the CGO.
2. Set Oxygen Flow to maintain a pressure of 20 kPa (3 psi).
   Maximum permissible flow is 200 ml/min.
3. Perform test with and without Vaporizer(s) fitted and with vaporizer(s) turned both ON and OFF.
4. Set oxygen flow to minimum and remove test equipment.

Common Gas Outlet Checks (CGO):

1. Check security and freedom of movement of CGO.
2. Check Safelock O-ring. DO NOT apply grease or lubricant
3. Check O_2 Emergency Flush flow rate is 35 - 75 L/min

Auxiliary Outlets:

1. Check outlets for security, damage and correct lock and release movement.
2. Check dynamic flow rate and that Oxygen Fail Whistle does not operate.

Oxygen Monitor (if fitted)
Function and Calibration Tests.

1. Connect a Test O_2 Analyser into the patient circuit.
2. Check that the machine O_2 sensor is inserted into the absorber O_2 sampling point.
3. Test both O_2 sensors in 100% Oxygen.
4. Expose both sensors to air and check reading is 21% ± 2.
   Adjust high and low O_2 alarms and check alarms trigger when values are lower or higher than reading on O_2 analyser respectively.
   Return the alarm levels to original settings.
5. Restore the sensor to correct location.
   Remove the test O_2 analyser.

Final Gas Concentration Tests.

1. Check concentration by Gas.
2. Check flowrate from CGO corresponds with flowmeter by concentration.
3. Set 3 L/min Oxygen and Nitrous Oxide flows.
   Check, using O_2 Monitor that the concentration from the CGO is 50% ± 2%.
4. Set Oxygen to 0.5 L/min, set N_2O to 0.5 L/min.
   Allow O_2 monitor to stabilise then check concentration is 50% ± 2%.
5. If fitted repeat above test substituting Carbon Dioxide for N_2O.
6. If fitted set Air to 3 L/min, set Oxygen to 3 L/min.
   Check Concentration reading on O_2 Monitor is 60% ± 2%.

Test Completion / Paperwork

1. Remove all test equipment from machine.
2. Drain all Gas from machine.
3. Turn OFF Gas Delivery Switch.
4. Turn Off all cylinders.
5. Turn off all Flow Control Valves.
6. Attach Service and Warning Labels.

Penlon recommends that after servicing the Anaesthetic Machine should be given an "Acceptance Check" by an Anaesthetist before being returned to Operational Use.

SERVICE SCHEDULE

8.3 Twelve Month Service Checks

(To be performed at 12, 36, and 60 Months of a 72-month cycle.)

NOTE:
AT 36 MONTHS ALL GAS-CARRYING PIPELINE HOSES SHOULD BE REPLACED. These are **not** included in the Preventive Maintenance Kits, please order separately.
AT 60 MONTHS ALL CYLINDER GAS SUPPLY PRESSURE REDUCING VALVES SHOULD BE REPLACED. These are **not** included in the Preventive Maintenance Kits, please order separately.

Machine Frame:

1. Check integrity of structure and security of all attachments.
2. Check for damage.
3. Check wheels for freedom of movement, check front braking.
4. Check that drawers and writing tablet move freely.

Electrical Safety Test:

1. Check mains lead and plug for damage.
2. Perform Electrical Safety Tests as relevant for country of use.
3. Check outlet sockets for correct function.

Pipeline Hose Checks:

1. Examine pipeline connectors, probes and hoses for cleanliness and damage.
2. Perform anti-confusion checks.
3. Replace pipeline filters
4. Perform pressure Leak Checks of all hoses with cylinders removed and Gas Delivery Switch in the OFF position.

Cylinder Yoke Assemblies:

1. Check for damage, cleanliness, all fittings are tight and clamping screws for freedom of movement.
2. Replace Bodok seals. DO NOT apply grease or lubricant
3. Replace yoke inlet filters.

Pressure Gauge and regulator checks:

1. Examine all pressure gauges for damage and clarity.
2. Check movement of needles is smooth.
3. Perform pressure Leak Test of all cylinder Gas Supplies with all Pipelines disconnected from supply.
   Perform this test with Gas Delivery Switch turned ON and Oxygen Basal Flow blanked off.
4. For Air / N20 repeat the test with the selector switch in the required position.
5. On completion of tests reinstate basal flow by removing test blanking plug.
6. Check output pressure of Primary Regulators.
7. Check output pressure of Secondary Regulators.

Flowmeter and Mechanical AHD Checks:

1. Check Flow Control Valves for smooth operation and positive off position.
2. Turn On Gas Delivery Switch
   Check Basal Flow of O_2 is delivered with all Flow Control Valves closed down.

All models - up to March 2002	100-200 ml/min
Cascade O_2 flowmeter- March 2002 onwards	50-75 ml/min
Single O_2 flowmeter - March 2002 onwards	100-200 ml/min

3. Check flow tubes.

SERVICE SCHEDULE

4. Check Bobbin Floats move freely and rotate within the glass tube.
5. Check maximum flow capability of all gases.
6. If CO2 is fitted check that the maximum flow is restricted to 500-600 ml/min flow rate.
7. Connect O2 Monitor to CGO.
8. Close all gas flow valves.
9. Ensure N2O / Air Selection switch is positioned for N2O.
10. Fully open N2O Flow Control Valve
    Check that ***no*** flow of nitrous oxide occurs.
11. Slowly operate O2 control valve throughout range and check that N2O now flows.
12. Operate N2O/Air selector switch to Air position and check that N2O ceases to flow and that Air is now available.
13. Return switch to the N2O position and set the oxygen flow back to minimum.
    Refer to the table below, and check % Oxygen concentration at the oxygen flows specified.
    Adjust the Oxygen Flowmeter control only - Do NOT adjust the N2O flowmeter.
    Note The flow rates for N2O are given as a guide only.

O2 Flow	%O2 (in O2/N2O mixture)	N2O Flow
*0.25 L/min	27 - 33 %	0.5 - 0.67
*0.5 L/min	27 - 33 %	1.0 - 1.35
0.8 L/min	27 - 33 %	1.6 - 2.1
1.5 L/min	27 - 33 %	3.0 - 4.1
3.0 L/min	27 - 33 %	6.1 - 8.1

*Cascade flowmeter models - March 2002 onwards

14. Repeat tests by reducing Oxygen flow back to Basal Flow conditions, referring to the values in the above table.
15. Check gas delivery switch for correct operation

Oxygen Fail Alarms:

1. Simulate an Oxygen fail by unplugging the Oxygen Pipeline from the outlet.
   Check that before the supply of oxygen is exhausted that the Oxygen Fail Whistle sounds for a minimum of 7 seconds.
   Check that any Nitrous Oxide and Carbon Dioxide (if fitted) Gas Flows are cut off.
2. Check that the Oxygen Supply Visual Indicator turns from fully green to fully red.
3. Turn on Oxygen cylinder.
   Check Oxygen Basal flow reinstated and whistle sounds briefly.
4. Turn off Oxygen cylinder and repeat above tests.

Back Bar Assembly - Selectatec - Checks.

1. Replace Selectatec O-rings. DO NOT apply grease or lubricant
2. Replace flexible tubing from back bar outlet to CGO - 1.35 m
3. Replace vaporizer locking spring
4. Check all pillar valves open and seal correctly.
5. Check pillar valve inserts sit proud or flush with the pillar valve.
   A sunken pillar valve insert denotes failure of the internal spring.
6. Check vaporizer interlock system for correct operation.

Back Bar Assembly - Cagemount - Checks.

1. Replace flexible hoses.
2. Replace flexible hose from back bar to CGO - 1.35 m
3. Check security of taper connectors
   Use Fomblin or other Oxygen-safe grease to lightly lubricate the metal surface where male and female connector come into contact with each other.

SERVICE SCHEDULE

Fresh Gas Pressure Relief Valve (PRV) Test.

1. Occlude CGO with a manometer.
2. At 10 L/min Flowrate of Oxygen, the PRV relieves at 41 kPa ± 10%.

Leak Test From Flowmeter to Common Gas Outlet

1. Fit a suitable Manometer Test gauge to the CGO.
2. Set Oxygen Flow to maintain a pressure of 20 kPa (3 psi).
   Maximum permissible flow is 200 ml/min.
3. Perform test with and without Vaporizer(s) fitted and with vaporizer(s) turned both ON and OFF.

4 Set oxygen flow to minimum and remove test equipment.

Common Gas Outlet Checks (CGO):

1. Check security and freedom of movement of CGO.
2. Replace Safelock O-ring. DO NOT apply grease or lubricant
3. Check O2 Emergency Flush flowrate is 35 - 75 L/min

Auxiliary Outlets:

1. Check outlets for security, damage and correct lock and release movement.
2. Check dynamic flowrate and that Oxygen Fail Whistle does not operate.

Oxygen Monitor (if fitted)
Function and Calibration Tests.

1. Connect a Test O2 Analyser into the patient circuit.
2. Check that the machine O2 sensor is inserted into the absorber O2 sampling point.
3. Test both O2 sensors in 100% Oxygen.
4. Expose both sensors to air and check reading is 21% ± 2.
   Adjust high and low O2 alarms and check alarms trigger when values are lower or higher than reading on O2 analyser respectively.
   Return the alarm levels to original settings.
5. Restore the sensor to correct location.
   Remove the test O2 analyser.

Final Gas Concentration Tests.

1. Check concentration by Gas.
2. Check flowrate from CGO corresponds with flowmeter by concentration.
3. Set 3 L/min Oxygen and Nitrous Oxide Flows.
   Check, using O2 Monitor that the concentration from the CGO is 50% ± 2%.
4. Set Oxygen to 0.5 L/min, set N2O to 0.5 L/min.
   Allow O2 monitor to stabilise then check concentration is 50% ± 2%.
5. If fitted repeat above test substituting Carbon Dioxide for N2O.
6. If fitted set Air to 3 L/min, set Oxygen to 3 L/min.
   Check Concentration reading on O2 Monitor is 60% ± 2%.

Test Completion / Paperwork

1. Remove all test equipment from machine.
2. Drain all Gas from machine.
3. Turn OFF Gas Delivery Switch.
4. Turn Off all cylinders.
5. Turn off all Flow Control Valves.
6. Attach Service and Warning Labels.

Penlon recommends that after servicing the Anaesthetic Machine should be given an "Acceptance Check" by an Anaesthetist before being returned to Operational Use.

SERVICE SCHEDULE

8.4 Twenty-Four Month Service Checks (To be performed at 24, and 48 Months of a 72-month cycle.)

Machine Frame:

1. Check integrity of structure and security of all attachments.
2. Check for damage.
3. Check wheels for freedom of movement and braking.
4. Check drawers, writing tablet move freely.

Electrical Safety Test:

1. Check mains lead and plug for damage.
2. Perform Electrical Safety Tests as relevant for country of use.
3. Check outlet sockets for correct function.

Pipeline Hose Checks:

1. Examine pipeline connectors, probes and hoses for cleanliness and damage.
2. Perform anti-confusion checks.
3. Replace pipeline filters
4. Perform pressure Leak Checks of all hoses with cylinders removed and Gas Delivery Switch in the OFF position.

Cylinder Yoke Assemblies:

1. Check for damage, cleanliness, all fittings are tight and clamping screws for freedom of movement.
2. Replace Bodok seals. DO NOT apply grease or lubricant
3. Replace yoke inlet filters.

Pressure Gauge and regulator checks:

1. Examine all pressure gauges for damage and clarity.
2. Check movement of needles is smooth.
3. Perform pressure Leak Test of all cylinder Gas Supplies with all Pipelines disconnected from supply.
   Perform this test with Gas Delivery Switch turned ON and Oxygen Basal Flow blanked off.
4. For Air / N20 repeat the test with the selector switch in the required position.
5. On completion of tests reinstate basal flow by removing test blanking plug.
6. Check output pressure of Primary Regulators.
7. Check output pressure of Secondary Regulators.

Flowmeter and Mechanical AHD Checks:

1. Turn off all cylinders disconnect pipeline hoses and drain all gases from the machine.
2. Replace flowmeter tube seals and filters.
3. Check Flow Control Valves for smooth operation and positive off position.
4. Turn On Gas Delivery Switch
   Check Basal Flow of Oxygen is delivered with all Flow Control Valves closed down.

All models - up to March 2002	100-200 ml/min
Cascade O2 flowmeter- March 2002 onwards	50-75 ml/min
Single O2 flowmeter - March 2002 onwards	100-200 ml/min

5. Check flow tubes.
6. Check Bobbin Floats move freely and rotate within the glass tube.
7. Check maximum flow capability of all gases.
8. If CO2 is fitted check that the maximum flow is restricted to 500-600 ml/min flow rate.
9. Connect O2 Monitor to CGO.
10. Close all gas flow valves.

SERVICE SCHEDULE

11. Ensure N2O / Air Selection switch is positioned for N2O.
12. Fully open N2O Flow Control Valve
    Check that NO flow of N2O occurs.
13. Slowly operate O2 control valve throughout range and check that N2O now flows
14. Operate N2O/Air selector switch to Air position and check that N2O ceases to flow and that Air is now available.
15. Return switch to the N2O position and set the oxygen flow back to minimum.
    Refer to the table below, and check % Oxygen concentration at the oxygen flows specified .
    Adjust the Oxygen Flowmeter control only - Do NOT adjust the N2O flowmeter.
    Note The flow rates for N2O are given as a guide only.

O2 Flow	%O2 (in O2/N2O mixture)	N2O Flow
*0.25 L/min	27 - 33 %	0.5 - 0.67
*0.5 L/min	27 - 33 %	1.0 - 1.35
0.8 L/min	27 - 33 %	1.6 - 2.1
1.5 L/min	27 - 33 %	3.0 - 4.1
3.0 L/min	27 - 33 %	6.1 - 8.1

*Cascade flowmeter models - March 2002 onwards

16. Repeat tests by reducing Oxygen flow back to Basal Flow conditions, referring to the values in the above table.
17. Check gas delivery switch for correct operation

Oxygen Fail Alarms:

1. Simulate an Oxygen fail by unplugging the Oxygen Pipeline from the outlet.
   Check that before the supply of oxygen is exhausted that the Oxygen Fail Whistle sounds for a minimum of 7 seconds.
   Check that any Nitrous Oxide and Carbon Dioxide (if fitted) Gas Flows are cut off.
2. Check that the Oxygen Supply Visual Indicator turns from fully green to fully red.
3. Turn on Oxygen cylinder.
   Check Oxygen Basal flow reinstated and whistle sounds briefly.
4. Turn off Oxygen cylinder and repeat above tests.

Back Bar Assembly - Selectatec - Checks.

1. Replace Selectatec O-rings. DO NOT apply grease or lubricant
2. Replace flexible tubing from back bar outlet to CGO - 1.35 m
3. Replace vaporizer locking spring
4. Check all pillar valves open and seal correctly.
5. Check pillar valve inserts sit proud or flush with the pillar valve.
   A sunken pillar valve insert denotes failure of the internal spring.
6. Check vaporizer interlock system for correct operation.

Back Bar Assembly - Cagemount - Checks.

1. Replace flexible hoses.
2. Replace flexible hose from back bar to CGO - 1.35 m
3. Check security of taper connectors
   Use Fomblin or other Oxygen-safe grease to lightly lubricate the metal surface where male and female connector come into contact with each other.

Fresh Gas Pressure Relief Valve (PRV) Test.

1. Occlude CGO with a manometer.
2. At 10 L/min Flowrate of Oxygen the PRV relieves at 41 kPa ± 10%.

SERVICE SCHEDULE

Leak Test From Flowmeter to Common Gas Outlet

1. Fit a suitable Manometer Test gauge to the CGO.
2. Set Oxygen Flow to maintain a pressure of 20 kPa (3 psi).
   Maximum permissible flow is 200 ml/min.
3. Perform test with and without Vaporizer(s) fitted and with vaporizer(s) turned both ON and OFF.

4 Set oxygen flow to minimum and remove test equipment.

Common Gas Outlet Checks (CGO):

1. Check security and freedom of movement of CGO.
2. Replace Safelock O-ring. DO NOT apply grease or lubricant
3. Check O2 Emergency Flush flow rate is 35 - 75 L/min

Auxiliary Outlets:

1. Check outlets for security, damage and correct lock and release movement.
2. Check dynamic flowrate and that Oxygen Fail Whistle does not operate.

Oxygen Monitor (if fitted)
Function and Calibration Tests.

1. Connect a Test O2 Analyser into the patient circuit.
2. Check that the machine O2 sensor is inserted into the absorber O2 sampling point.
3. Test both O2 sensors in 100% Oxygen.
4. Expose both sensors to air and check reading is 21% ± 2.
   Adjust high and low O2 alarms and check alarms trigger when values are lower or higher than reading on O2 analyser respectively.
   Return the alarm levels to original settings.
5. Restore the sensor to correct location.
   Remove the test O2 analyser.

Final Gas Concentration Tests.

1. Check concentration by Gas.
2. Check flowrate from CGO corresponds with flowmeter by concentration.
3. Set 3 L/min Oxygen and Nitrous Oxide Flows.
   Check, using O2 Monitor that the concentration from the CGO is 50% ± 2%.
4. Set Oxygen to 0.5 L/min, set N2O to 0.5 L/min.
   Allow O2 monitor to stabilise then check concentration is 50% ± 2%.
5. If fitted repeat above test substituting Carbon Dioxide for N2O.
6. If fitted set Air to 3 L/min, set Oxygen to 3 L/min.
   Check Concentration reading on O2 Monitor is 60% ± 2%.

Test Completion / Paperwork

1. Remove all test equipment from machine.
2. Drain all Gas from machine.
3. Turn OFF Gas Delivery Switch.
4. Turn Off all cylinders.
5. Turn off all Flow Control Valves.
6. Attach Service and Warning Labels.

Penlon recommends that after servicing the Anaesthetic Machine should be given an "Acceptance Check" by an Anaesthetist before being returned to Operational Use.

SERVICE SCHEDULE

8.5 Seventy-Two Month Service Checks

(To be performed at 72 Months of a 72-month cycle.)

Machine Frame:

1. Check integrity of structure and security of all attachments.
2. Check for damage.
3. Check wheels for freedom of movement and braking.
3. Check wheels for freedom of movement, check front braking.
4. Check that drawers and writing tablet move freely.

Electrical Safety Test:

1. Check mains lead and plug for damage.
2. Perform Electrical Safety Tests as relevant for country of use.
3. Check outlet sockets for correct function.

Pipeline Hose Checks:

1. Examine pipeline connectors, probes and hoses for cleanliness and damage.
2. Perform anti-confusion checks.
3. Replace pipeline filters
4. Replace non-return valve o-rings.
5. Perform pressure Leak Checks of all hoses with cylinders removed and Gas Delivery Switch in the OFF position.

Cylinder Yoke Assemblies:

1. Check for damage, cleanliness, all fittings are tight and clamping screws for freedom of movement.
2. Replace Bodok seals. DO NOT apply grease or lubricant
3. Replace yoke inlet filters..
4. Replace non-return valve O-rings.

Pressure Gauge and regulator checks:

1. Examine all pressure gauges for damage and clarity.
2. Check movement of needles is smooth.
3. Perform pressure Leak Test of all cylinder Gas Supplies with all Pipelines disconnected from supply.
   Perform this test with Gas Delivery Switch turned ON and Oxygen Basal Flow blanked off.
4. For Air / N20 repeat the test with the selector switch in the required position.
5. On completion of tests reinstate basal flow by removing test blanking plug.
6. Check output pressure of Primary Regulators.
7. Replace secondary regulators
8. Check output pressure of Secondary Regulators.

Flowmeter and Mechanical AHD Checks:

1. Turn off all cylinders, disconnect pipeline hoses, and drain all gases from the machine.
2. Replace flowmeter tube seals and filters.
3. Check Flow Control Valves for smooth operation and positive off position.
4. Turn On Gas Delivery Switch
   Check Basal Flow of Oxygen is delivered with all Flow Control Valves closed.

All models - up to March 2002	100-200 ml/min
Cascade O2 flowmeter- March 2002 onwards	50-75 ml/min
Single O2 flowmeter - March 2002 onwards	100-200 ml/min

SERVICE SCHEDULE

5. Check flow tubes.
6. Check Bobbin Floats move freely and rotate within the glass tube.
7. Check maximum flow capability of all gases.
8. If CO2 is fitted check that the maximum flow is restricted to 500-600 ml/min flow rate.
9. Connect O2 Monitor to CGO.
10. Close all gas flow valves.
11. Ensure N2O / Air Selection switch is positioned for N2O.
12. Fully open N2O Flow Control Valve
    Check that NO flow of N2O occurs.
13. Slowly operate O2 control valve throughout range. Check that N2O now flows
14. Operate N2O/Air selector switch to Air position and check that N2O ceases to flow and that Air is now available.
15. Return switch to the N2O position and set the oxygen flow back to minimum.
    Refer to the table below, and check % Oxygen concentration at the oxygen flows specified .
    Adjust the Oxygen Flowmeter control only - Do NOT adjust the N2O flowmeter.
    Note The flow rates for N2O are given as a guide only.

O2 Flow	%O2 (in O2/N2O mixture)	N2O Flow
*0.25 L/min	27 - 33 %	0.5 - 0.67
*0.5 L/min	27 - 33 %	1.0 - 1.35
0.8 L/min	27 - 33 %	1.6 - 2.1
1.5 L/min	27 - 33 %	3.0 - 4.1
3.0 L/min	7 - 33 %	6.1 - 8.1

*Cascade flowmeter models - March 2002 onwards

16. Repeat tests by reducing Oxygen flow back to Basal Flow conditions, referring to the values in the above table.
17. Check gas delivery switch for correct operation

Oxygen Fail Alarms:

1. Simulate an Oxygen fail by unplugging the Oxygen Pipeline from the outlet.
   Check that before the supply of oxygen is exhausted that the Oxygen Fail Whistle sounds for a minimum of 7 seconds.
   Check that any N2O and Carbon Dioxide (if fitted) Gas Flows are cut off.
2. Check the Oxygen Supply Visual Indicator turns from fully green to fully red.
3. Turn on Oxygen cylinder.
   Check Oxygen Basal flow reinstated and whistle sounds briefly.
4. Turn off Oxygen cylinder and repeat above tests.

Back Bar Assembly - Selectatec - Checks.

1. Replace Selectatec O-rings. DO NOT apply grease or lubricant
2. Replace flexible tubing from back bar outlet to CGO - 1.35 m
3. Replace vaporizer locking spring.
4. Check all pillar valves open and seal correctly.
5. Check pillar valve inserts sit proud or flush with the pillar valve.
   A sunken pillar valve insert denotes failure of the internal spring.
6. Check vaporizer interlock system for correct operation.

Back Bar Assembly - Cagemount - Checks.

1. Replace flexible hoses.
2. Replace flexible hose from back bar to CGO - 1.35 m

SERVICE SCHEDULE

3. Check security of taper connectors
   Use Fomblin or other Oxygen-safe grease to lightly lubricate the metal surface where male and female connector come into contact with each other.

Fresh Gas Pressure Relief Valve (PRV) Test.
1. Occlude CGO with a manometer.
2. At 10 L/min Flowrate of Oxygen check the PRV relieves at 41 kPa ± 10%.

Leak Test From Flowmeter to Common Gas Outlet
1. Fit a suitable Manometer Test gauge to the CGO.
2. Set Oxygen Flow to maintain a pressure of 20 kPa (3 psi).
   Maximum permissible flow is 200 ml/min.
3. Perform test with and without Vaporizer(s) fitted and with vaporizer(s) turned both ON and OFF.

4 Set oxygen flow to minimum and remove test equipment.

Common Gas Outlet Checks (CGO):
1. Check security and freedom of movement of CGO.
2. Replace Safelock O-ring. DO NOT apply grease or lubricant
3. Replace emergency flush valve.
4. Check O2 Emergency Flush flow rate is 35 - 75 L/min

Auxiliary Outlets:
1. Check outlets for security, damage and correct lock and release movement.
2. Check dynamic flowrate and that Oxygen Fail Whistle does not operate.

Oxygen Monitor (if fitted)

1 Replace backup battery.

Oxygen Monitor - Function and Calibration Tests.
1. Connect a Test O2 Analyser into the patient circuit.
2. Check that the machine O2 sensor is inserted into the absorber O2 sampling point.
3. Test both O2 sensors in 100% Oxygen.
4. Expose both sensors to air and check reading is 21% ± 2.
   Adjust high and low O2 alarms and check alarms trigger when values are lower or higher than reading on O2 analyser respectively.
   Return the alarm levels to original settings.
5. Restore the sensor to correct location.
   Remove the test O2 analyser.

Final Gas Concentration Tests.
1. Check concentration by Gas.
2. Check flowrate from CGO corresponds with flowmeter by concentration.
3. Set 3 L/min Oxygen and Nitrous Oxide Flows.
   Check, using O2 Monitor that the concentration from the CGO is 50% ± 2%.
4. Set Oxygen to 0.5 L/min, set N2O to 0.5 L/min.
   Allow O2 monitor to stabilise then check concentration is 50% ± 2%.
5. If fitted repeat above test substituting Carbon Dioxide for N2O.
6. If fitted set Air to 3 L/min, set Oxygen to 3 L/min.
   Check Concentration reading on O2 Monitor is 60% ± 2%.

Test Completion / Paperwork
1. Remove all test equipment from machine.

SERVICE SCHEDULE

2. Drain all Gas from machine.
3. Turn OFF Gas Delivery Switch.
4. Turn Off all cylinders.
5. Turn off all Flow Control Valves.
6. Attach Service and Warning Labels.

Penlon recommends that after servicing the Anaesthetic Machine should be given an "Acceptance Check" by an Anaesthetist before being returned to Operational Use.

9. SERVICING PROCEDURES

9.1 Servicing

The Prima SP range of anaesthetic machines must only be serviced by a Penlon-trained engineer to the following service schedule:

Every 6 months
Inspection and Function Check
Every 12 months
Annual service which includes routine replacement of seals, etc. as preventive maintenance
At 3 years interval
Pipeline hoses - replace
At 5 years interval
Primary regulators - replace
Every 2 and 6 years
Additional tests / component replacement

Details of these service operations are given in this Prima SP Service Manual, available only to Penlon trained engineers.

Mechanical AHD System
Additional servicing for the mechanical AHD system only.
Function Test
(At 6 month intervals, see section 6.8 to 6.11)
Additional Servicing
(At 12 month intervals)
Secondary Regulators - check pressure setting
Gear linkage - inspect

Service Tools

015067
Regulator Spanner - Regulators manufactured by 'Gas Arc'

800612
Flow setting tool

9.2 Ancillary Equipment

9.2.1 Sigma Delta Vaporizer

Follow the instructions given in section 8 of the user instruction manual. These include:
Every 6 months
Function test and calibration test
Every 10 years
Major overhaul (if unit to be used beyond 10 years).
Note: Halothane vaporizers - major overhaul required at 5 years.
On vaporizers with interlock, test the function of the interlock system during the vaporizer calibration test.

9.2.2 Monitor

Follow the service recommendations detailed in the monitor user instruction manual.

9.2.3 AV800 / AV900 Ventilator

If the anaesthetic machine was supplied with an AV-series ventilator, follow the instructions given in section 7 of the user instruction manual.
These include:

Every 6 months
Inspection and Function Check

Every 12 months (or 1200 hours)
Replace bellows

Every 12 months
Replace O-seals and oxygen inlet filter, etc., as preventive maintenance.

Every 5 years
Replace batteries
Fit service-exchange pneumatic assembly

9.2.4 Anaesthetic Gas Scavenging System

Follow the service recommendations detailed in the AGSS user instruction manual.

9.2.5 Circle System Absorber

Follow the service recommendations detailed in the circle absorber user instruction manual.

SERVICING PROCEDURES

9.3 Cleaning and Sterilisation

Frequently wipe over the external surfaces of the machine, the vaporizers, with a damp cloth. Always allow the machine to dry off thoroughly before using it.

(Mild antiseptic solutions may be used but should be rinsed off with clean water.)

Breathing system hoses and other components must be sterilised to the manufacturer's recommended methods.

Monitor

Refer to the monitor user instruction manual.

Ventilator

AV-series Ventilator Bellows Assembly Cleaning

The user must follow the detailed instructions included in section 7.5 of the ventilator user instruction manual.

Never use any hard object or abrasive agent to clean any of the components, only a soft cloth.

If the valve seat is damaged, the diaphragm valve will leak and this may cause serious malfunction.

CAUTION

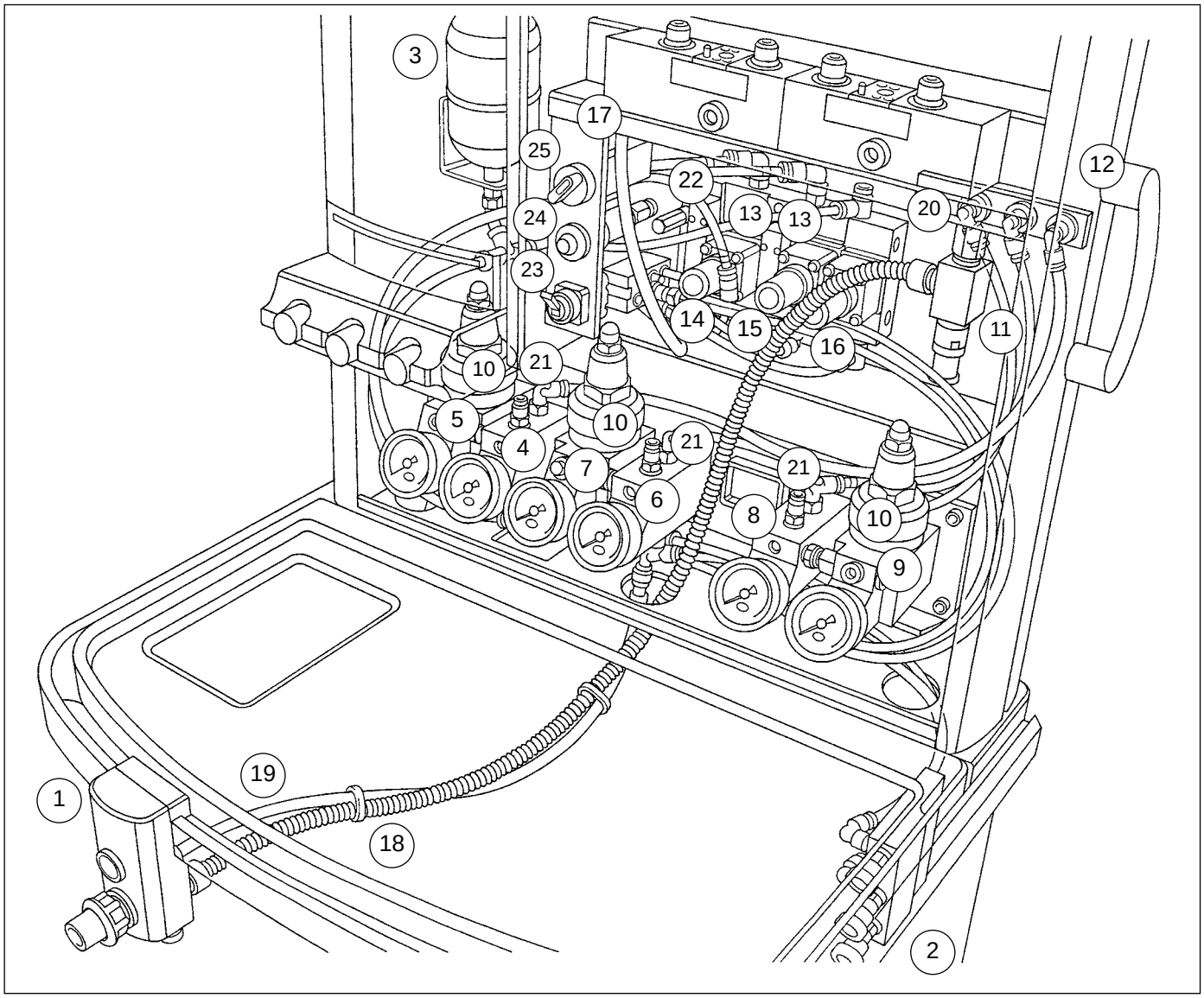
Do not use any cleaning solution containing alcohol or any harsh abrasive cleaning agent on the bellows housing.

Sterilisation

The user must follow the detailed instructions included in section 7 of the ventilator user instruction manual.

WARNING

Do not autoclave the bellows housing. The exhalation diaphragm valve assembly must be disassembled prior to sterilisation - do not sterilise the diaphragm.



Gas System Components

(UK Specification 3-gas machine)

1. CGO block
2. Auxiliary outlet block
3. Reservoir (O_2 - for whistle)
4. Low pressure block (O_2)
5. High pressure block (O_2)
6. Low pressure block (Air)
7. High pressure block (Air)
8. Low pressure block (N_2O)
9. High pressure block (N_2O)
10. High pressure regulator
11. Fresh gas pressure relief valve
12. Pipeline supply inlet block
13. Cut-off valve capsules
14. Secondary regulator (O_2)
15. Secondary regulator (N_2O)
16. Secondary regulator (Air)

Note: a) Test points are mounted beneath each secondary regulator.
b) On pre-2002 machines, the regulators are mounted vertically.

17. Hose from flowmeter
18. Fresh gas hose
19. O_2 flush hose
20. Manifold block
21. Test point - primary regulator
22. Warning whistle
23. Air/N_2O interlock switch
24. O_2 failure visual indicator
25. Gas delivery switch

9.4 Gas System Components

The illustration on the preceding page shows the components visible when the front cover is removed.

Machines with CO_2:
An additional high pressure block and regulator, and an additional cut-off valve capsule are fitted.

9.5 Internal Gas Pipework

9.5.1 Identification

Internal pipework is colour coded and diameter indexed, as follows:

Colour codes

Oxygen	White (or Green, on US specification machines)
Nitrous Oxide	Blue
Medical Air	Black/white (or Yellow on US specification machines)
Carbon Dioxide	Grey

Tubing diameter

Oxygen	8 mm
Nitrous Oxide	6 mm
Medical Air	5 mm
Carbon Dioxide	4 mm
Mixed Gas	10 mm

9.5.2 Tubing Connectors

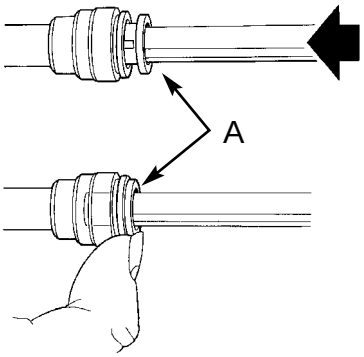
Push-in type fittings are used throughout the low pressure circuit

To connect and disconnect the tubing from the connectors, follow the procedures detailed below.

Do not use excess force.

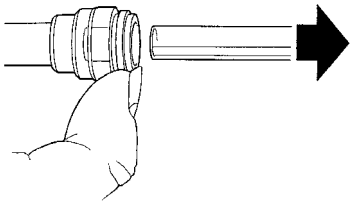
Disconnecting tubing from connector

Push in the tube and the connector end piece ‘A’.



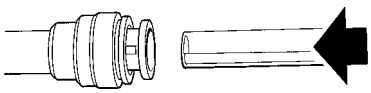
Hold the end piece ‘A’ in place.

Pull the tube out to disconnect.



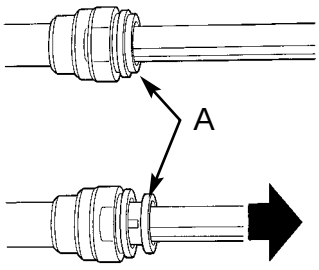
Fitting tubing to connector

Push in the tube as far as possible
Do not use excessive force.



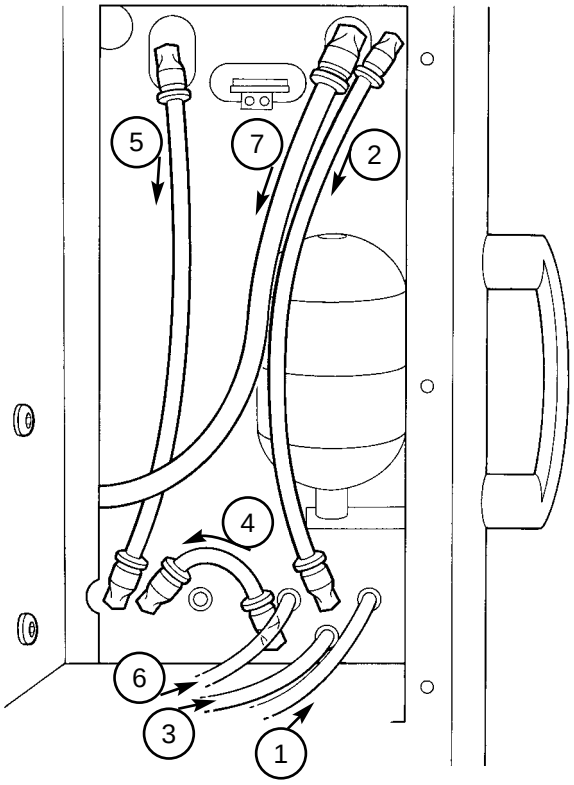
The connector end piece ‘A’ will also move inwards.

Pull the tube carefully outwards.
The end piece ‘A’ will be pulled outwards to the ‘locked’ position.



9.5.3 Cascade Flowmeter Assembly Tubing

The illustration shows the rear of a three-gas flowmeter assembly, with cascade oxygen and nitrous-oxide flowmeter assemblies, as fitted to a UK specification machine with mechanical AHD.



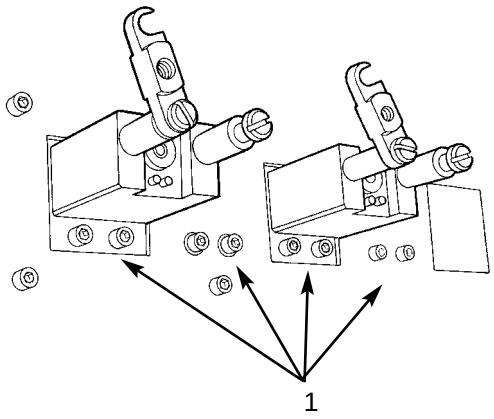
1. Oxygen supply
2. Oxygen - low flow tube to high flow tube
3. Nitrous oxide - supply to primary needle valve
4. Nitrous oxide - link to secondary needle valve (mechanical AHD)
5. Nitrous oxide - low flow tube to high flow tube
6. Air - supply to flowmeter needle valve
7. Mixed gas supply to backbar manifold.

SERVICING PROCEDURES

9.6 Front Cover - Remove and Refit

CAUTION

Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

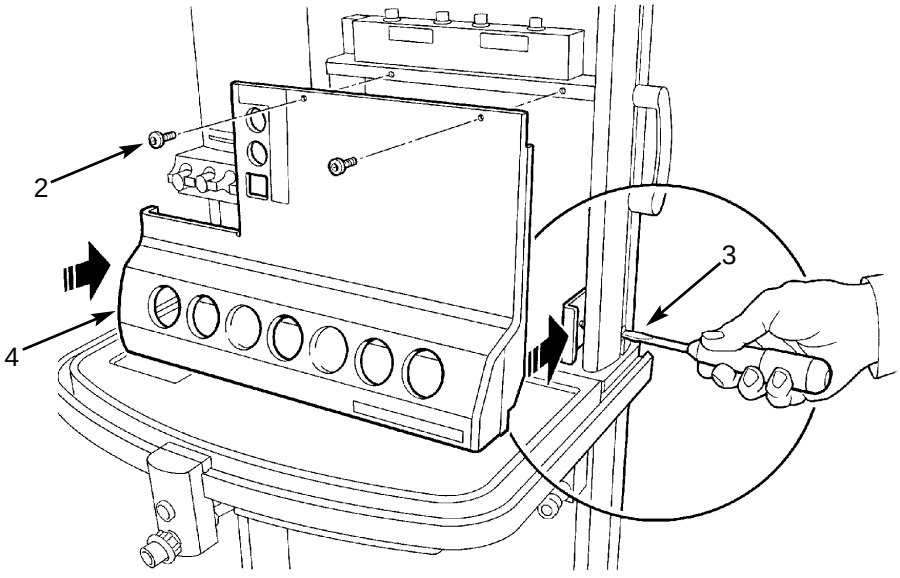


Removal

1. Remove all cylinders, and disconnect Pipeline supply hoses.
2. At the rear of the machine, slacken the screws (1) securing the gas blocks.
3. Remove the two top fixing screws (2) securing the panel to the front of the machine.
4. Slacken each screw (3) on the side of the machine, to loosen the side clamp plates.
5. Carefully pull the cover (4) away from the front of the machine.

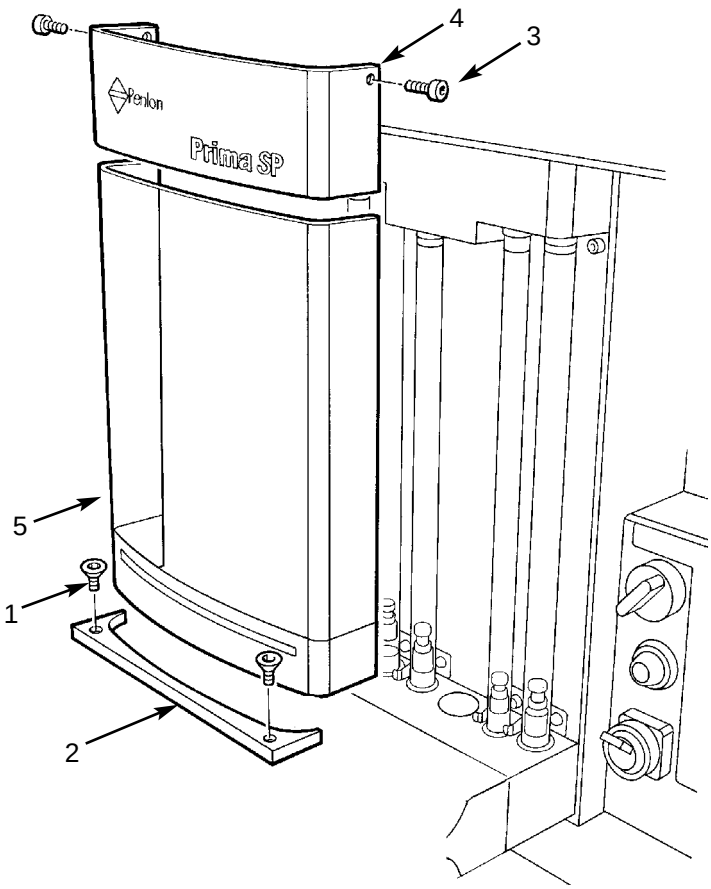
Refit

6. Line up the cover with the gauges and switches.
7. Check that the clamp plate on each side of the machine is positioned to allow the sides of the cover to fit between each plate and the frame.
8. Carefully push the cover into place.
9. Screw in the top fixings (2). Do NOT tighten.
10. Tighten the clamp plate screws (3).
11. Tighten the top fixings (2).
12. At the rear of the machine, tighten the screws (1)



SERVICING PROCEDURES

9.7 Flowmeter Cover



Removal

1. Slacken the screws (1) securing the filler strip (2).
2. Remove the screws (3) and top guard (4).
3. Remove the cover (5).

Refitting

4. Reverse the removal procedure.

SERVICING PROCEDURES

9.8 Mechanical AHD System

9.8.1 Check and Adjust Basal Flow

All models - up to March 2002
Oxygen basal flow 100-200 ml/min

Cascade flowmeter models - March 2002 onwards
Oxygen basal flow 50-75 ml/min

Single flowmeter models - March 2002 onwards
Oxygen basal flow 100-200 ml/min

NOTE: The machine must be on a flat surface.

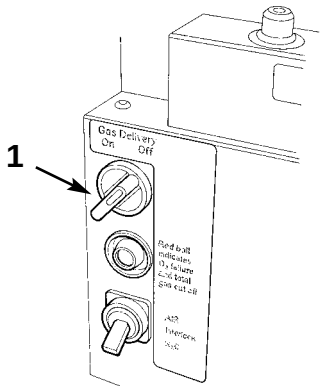
1. Check that all flowmeter controls are OFF.

2. Switch the gas delivery switch (1) to ON.

3. Check that a basal flow of oxygen is indicated, as shown above.
   If the basal flow is outside the range given above:
   a) adjust the output of the secondary Oxygen regulator, (see section 9.11) to achieve the correct basal flow.
   b) check the oxygen concentration, see section 9.8.2.

4. Switch the Gas Delivery switch to OFF.

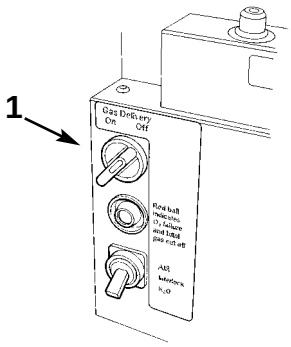
5. If the correct basal flow can not be achieved, reset the gear linkage - see section 9.8.3.



SERVICING PROCEDURES

9.8.2 Check Oxygen Concentration

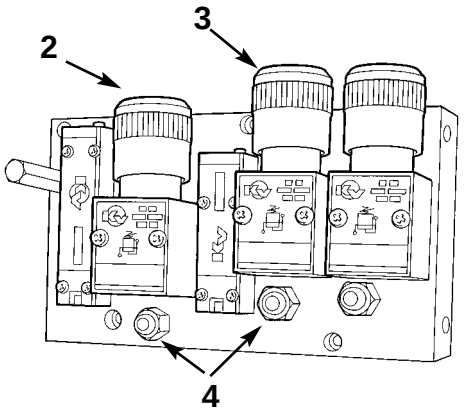
NOTE: The machine must be on a flat surface.



1. If the machine is not fitted with an Oxygen monitor, connect a stand-alone analyser to the CGO outlet.
2. Set the Gas Delivery switch (1) to ON.
3. Turn the Nitrous Oxide flowmeter control to maximum.
4. Refer to the table below, and check % Oxygen concentration at the oxygen flows specified .
   Adjust the Oxygen Flowmeter control only - Do NOT adjust the N_2O flowmeter.
   Note The flow rates for N_2O are given as a guide only.

O_2 Flow	***%O_2 (in O_2/N_2O mixture)***	*N_2O Flow*
***0.25 L/min	27 - 33 %	0.5 - 0.67
***0.5 L/min	27 - 33 %	1.0 - 1.35
0.8 L/min	27 - 33 %	1.6 - 2.1
1.5 L/min	27 - 33 %	3.0 - 4.1
3.0 L/min	27 - 33 %	6.1 - 8.1

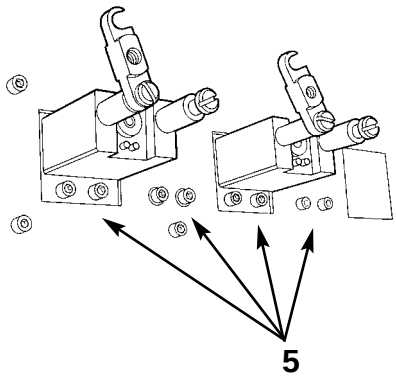
***Cascade flowmeter models - March 2002 onwards**



NOTE:
Early type regulators shown in illustration

If the %O_2 concentration is outside the range given above, at any of the set flows, adjust the output of either or both of the secondary regulators (oxygen - 2) (nitrous oxide - 3), as follows:

5. Switch the Gas Delivery switch to OFF.
6. Remove the front cover - follow the procedure given in section 9.6.
   Retighten the screws (5) securing the gas blocks.
   Reconnect the cylinder and pipeline supplies.
7. Attach a pressure gauge to the regulator test point (4).
8. Switch the Gas Delivery switch to ON.
9. To increase output: turn the regulator cap, (2 or 3) slowly clockwise.
   To decrease output: turn the regulator cap fully anti-clock-wise, then clockwise to the correct setting.
   Maintain the output pressure within the ranges:



All models - up to March 2002
Secondary regulator pressure 207 - 283 kPa (30 - 41 psi)

All models - March 2002 onwards
Secondary regulator pressure 152 - 241 kPa (22 - 35 psi)

10. If the correct basal flow can not be achieved, reset the gear linkage - see section 9.8.3.
11. Recheck the Oxygen Concentration.

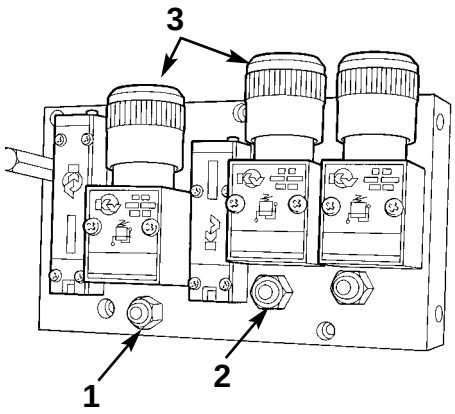
SERVICING PROCEDURES

9.8.3 Gear Linkage - Reset

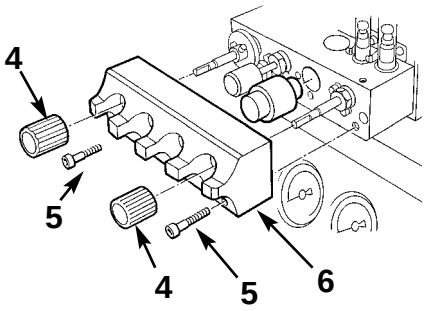
Cascade and Single Flowmeter Tube Systems
March 2002 Onwards

NOTE: ***The machine must be on a flat surface.***

Set the secondary regulators

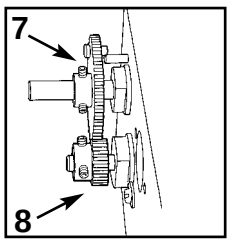


1. Set the Gas Delivery Switch to OFF.
2. Disconnect all pipeline and cylinder supplies.
3. Remove the front cover - see section 9.6.
   Retighten the screws securing the gas blocks.
   Reconnect the cylinder and pipeline supplies.
4. Attach a pressure gauge to the oxygen regulator test point (1).
   (Early type regulators shown in illustration)
5. Set the Gas Delivery Switch to ON.
6. Set a flow of 5 L/min Oxygen.
   Reset the O_2 secondary regulator to 172 kPa (25.0 psi).
7. To increase output: turn the regulator cap, (3) slowly clockwise.
   To decrease output: turn the regulator cap fully anti-clockwise, then clockwise to the correct setting.
8. Return the flow to minimum.
9. Attach a pressure gauge to the N_2O regulator test point (2).

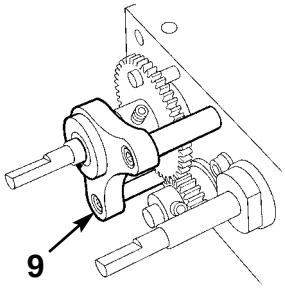


10. Set a flow of 5 L/min nitrous oxide.
    Reset the N_2O secondary regulator to 186 kPa (27.0 psi).
    To increase output: turn the regulator cap, (3) slowly clockwise.
    To decrease output: turn the regulator cap fully anti-clockwise, then clockwise to the correct setting.
    Return the flow to minimum.
11. Set the Gas Delivery Switch to OFF.

Gear Linkage



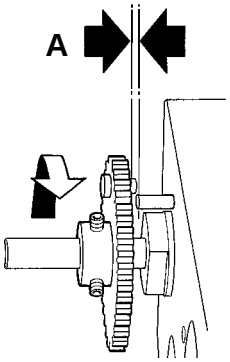
12. Remove the flowmeter control knobs (4), screws (5) and control knob cover (6).
13. Loosen the grubscrews and remove the O_2 gear (7) and small N_2O gear (8).
14. Check the condition of the gears and grubscrews. Replace with new components if necessary.
    Clean all traces of Loctite from the grubscrews and apply new Loctite 242.
15. Check that each gear slides easily on its shaft.
16. Set the Gas Delivery Switch to ON.
17. Open the N_2O valve to maximum, to check full flow.
18. Close the valve gently until the N_2O bobbin ceases to rotate.
    Do not over tighten the valve when closing - this will cause irreparable damage to the valve seat.



19. Fit the O_2 gear (7) on the shaft.
    Fit the Setting Tool (9). Part No. 800612.

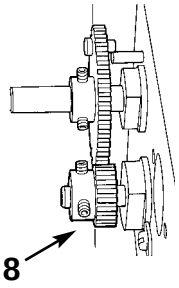
SERVICING PROCEDURES

20. Fit the O_2 control knob and open the O_2 control valve, to check full flow.
Cascade Flowmeter Tube Models:
Close the valve until a flow of 50-75 ml/min is obtained.
Single Flowmeter Tube Models:
Close the valve until a flow of 100-200 ml/min is obtained.



21 Distance the inner face of the O_2 gear with a 0.1 mm feeler gauge at 'A'.
Tighten the grubscrews.
Check the flow returns to the basal flow set in operation 20, above.

22. Refit the N_2O gear (8) - be careful not to move either shaft. Tighten the grub screws.



23. Apply a small amount of BG 87 to the gears.

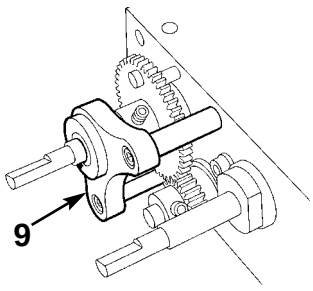
24. If the machine is not fitted with an Oxygen monitor, connect a stand-alone analyser to the CGO outlet.

25. Check Oxygen concentration:

26. Turn the Nitrous Oxide flowmeter control to maximum.
Refer to the table below, and check % Oxygen concentration at the Oxygen flows specified .
Adjust the Oxygen Flowmeter control only - Do NOT adjust the N_2O flowmeter.
Note The flow rates for N_2O are given as a guide only.

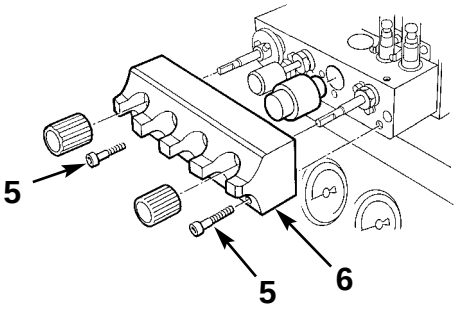
O_2 Flow	***%O_2 (in O_2/N_2O mixture)***	*N_2O Flow*
***0.25 L/min	27 - 33 %	0.5 - 0.67
***0.5 L/min	27 - 33 %	1.0 - 1.35
0.8 L/min	27 - 33 %	1.6 - 2.1
1.5 L/min	27 - 33 %	3.0 - 4.1
3.0 L/min	27 - 33 %	6.1 - 8.1

*Cascade flowmeter models - March 2002 onwards



If the %O2 concentration is outside the range given above, at any of the set flows, adjust the output of either or both of the secondary regulators - see 9.8.2.

NOTE Maintain output pressures within the range:
152 - 241 kPa (22 - 35 psi)



27. Check the Oxygen basal flow - see 9.8.1.
28. Recheck the Oxygen Concentration.
29. Remove the O_2 control knob and the Setting Tool (9).
30. Carefully refit the control knob cover (6) and screws (5), ensuring that the basal flow does not change.
Fit the O_2 and N_2O control knobs.

9.8.4 Gear Linkage - Reset (Models built up to Feb 2002

CAUTION

Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

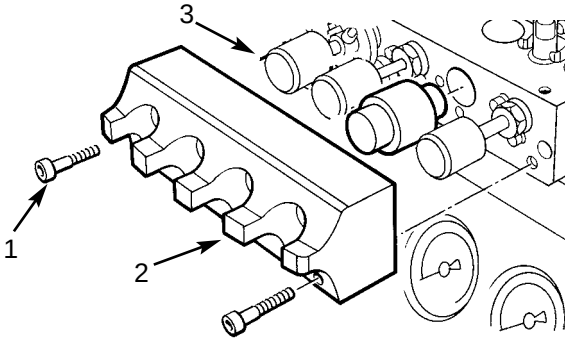
Removal

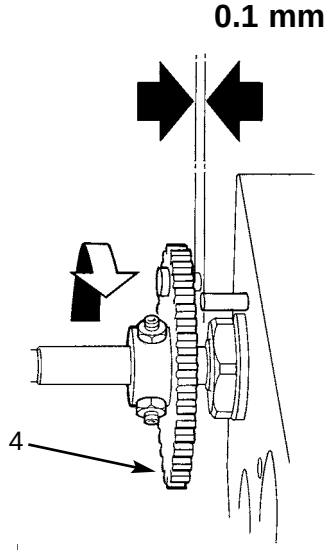
1. Remove all cylinders, and disconnect Pipeline supply hoses.
2. Remove the two screws (1) and control knob cover (2).
3. Check the condition of the gears and grubscrews, and replace if necessary.
4. To reset the gears, first remove the O_2 gear (4) only.
5. Turn the Gas Delivery switch (5) to On. Gently close the N_2O primary valve so that the N_2O flowmeter bobbin reseats.

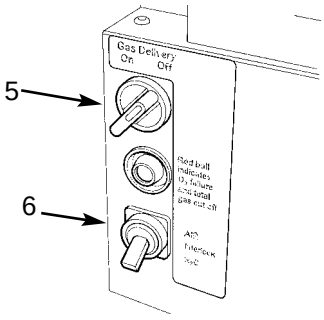
   NOTE
   a) This valve is closed by turning the needle anti-clockwise.
   b) On machines with Air, set the Air/N_2O interlock switch (6) to N_2O).

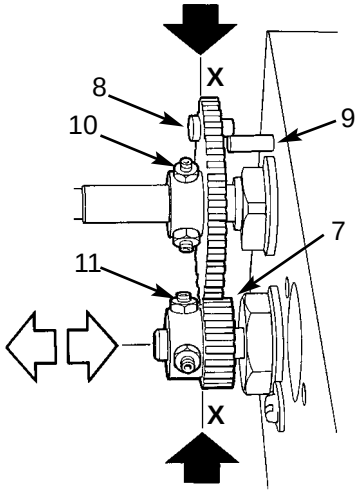
6. Set the oxygen control valve so that a basal flow of 150 ml/min of oxygen is supplied.
7. Remove the N_2O gear (7).
   Carefully replace the O_2 gear so that the gear stop (8) is positioned anti-clockwise, and just touching the mechanical stop (9) in the front of the manifold block (see illustration).
8. Distance the inner face of the O_2 gear from the mechanical stop with a 0.1 mm feeler gauge.
   Tighten the grubscrews (10) to secure the O_2 gear.
9. With the O_2 gear against the stop, replace the N_2O gear and push on so that the front faces of the gears are flush, see X-X as illustrated.
   Note that the rear face of the N_2O gear is closer to the manifold block than the O_2 gear.

   Tighten the grubscrews (11) to secure the N_2O gear.
   Apply a small amount of Molycote BG87 grease, evenly distributed, to the O_2 and N_2O gear teeth.





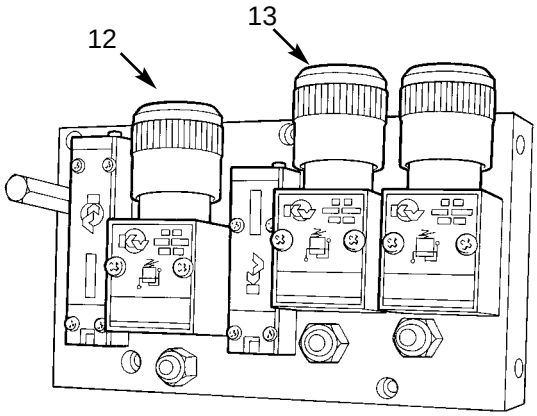




SERVICING PROCEDURES

Gas Flow

10. Check the gas flows. See Function Test, section 6.7.
11. If the gas flows are inaccurate, small adjustments can be made by adjusting the oxygen basal flow within the range 150 - 200 ml, and then using the secondary regulators, as follows.
12. Attach a pressure gauge to the test point on each regulator (12 - oxygen, 13 - nitrous oxide).
    At 5 L/min flow both regulators should be set at 275 kPa (40 psi), but adjustment is available from 261 to 289 kPa (35 to 41 psi).
13. If the N_2O flow is low the N_2O pressure should be increased to 289 kPa (41 psi), before the O_2 pressure is reduced to 261 kPa (35 psi).
14. Similarly, if the N_2O flow is high, the O_2 pressure should be increased, before the N_2O pressure is reduced.
15. Carry out a full function test on the machine, see section 6.

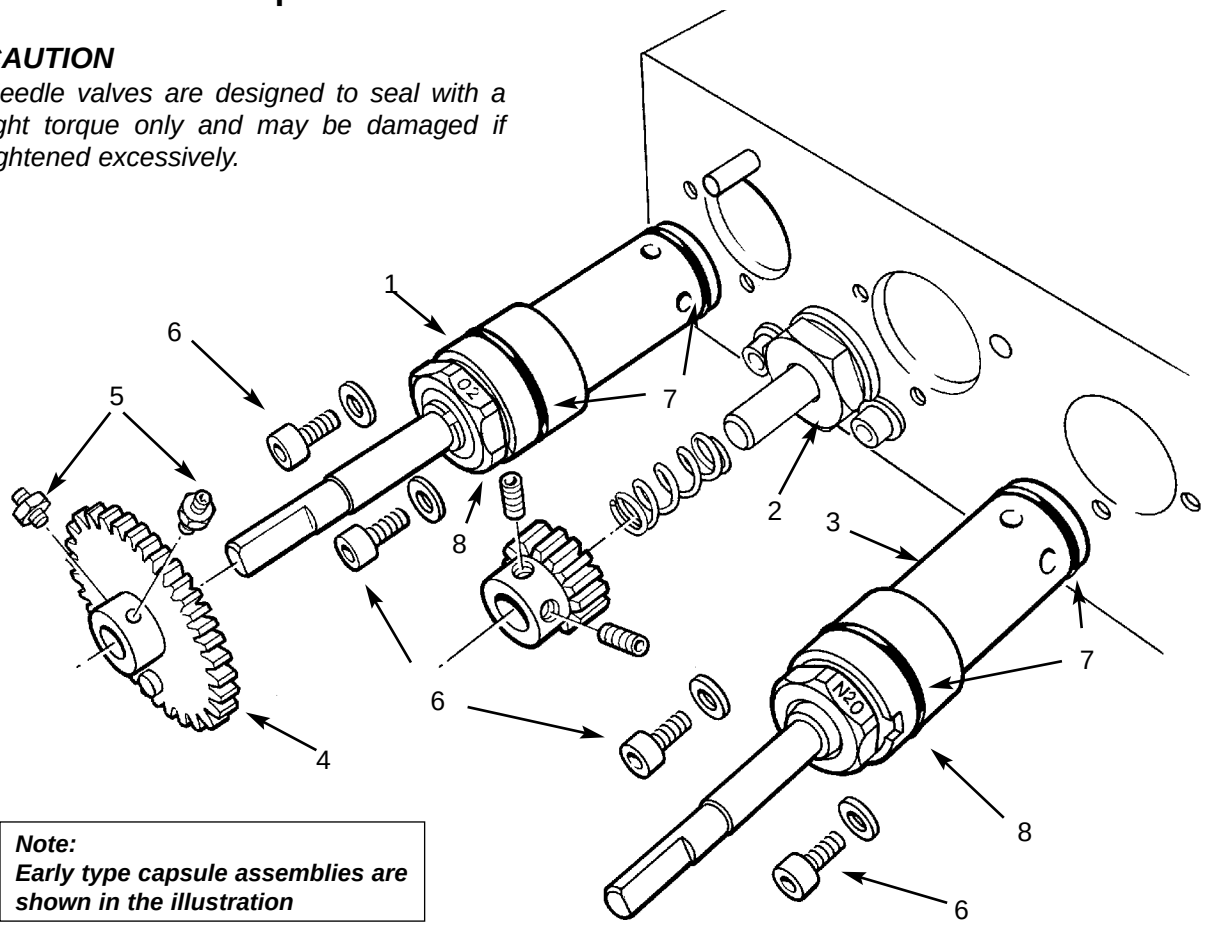


Note:
On machines built from March 2002, the regulators are mounted horizontally

SERVICING PROCEDURES

9.9 Control Valve Capsule Removal/Replacement

CAUTION
Needle valves are designed to seal with a light torque only and may be damaged if tightened excessively.



Note:
Early type capsule assemblies are shown in the illustration

Note:
There are no user serviceable components within the flow control valve capsules (1, 2, and 3).
This procedure relates only to the exchange of the complete, factory set, valves.

1. Remove all gas cylinders and disconnect all gas pipeline hoses.

CAUTION
Ensure that all gas supplies are exhausted before commencing these procedures. High pressure gas can 'fire' the valve out of the machine.

2. Remove the cover and flowmeter knobs, as detailed in section 9.8.
3. If the O_2 valve capsule (1) is to be removed, take off the O_2 gear (4) by loosening the grubscrews (5).
4. Undo the two securing screws and washers (6) and withdraw the capsule (1).
5. To replace the flow control valve, lightly smear the O-seals (7) with Fomblin and insert the capsule into the manifold block.
6. Align the two slots (8) with the securing screw holes, and refit the screws and washers (6).
7. If necessary reset the gears, as detailed in section 9.8, and check the gas flows.
8. Replace the flowmeter knobs and cover.
9. Perform a function test, section 6.

9.10 Oxygen Reservoir - Removal/Replacement

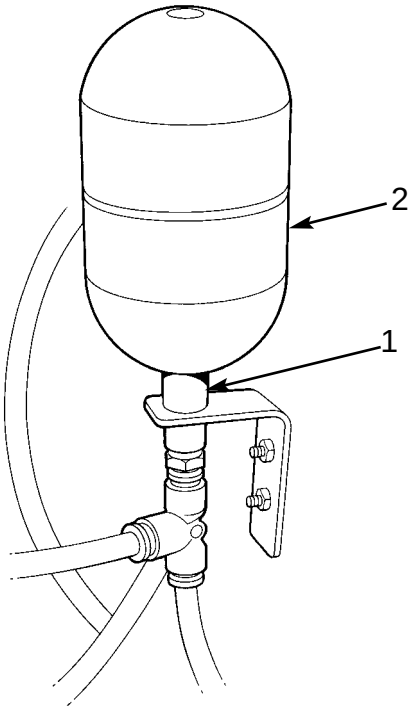
1. Remove all oxygen cylinders and disconnect the oxygen pipeline hose.

CAUTION
Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

2. Remove the cover at the back of the machine to gain access to the rear of the flowmeter assembly.

3. Unscrew the nut (1) to release the oxygen reservoir (2) from the mounting bracket.

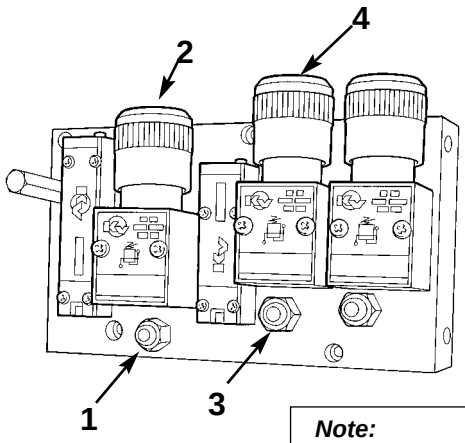
4. After refitting, perform a function test, section 6.



Note:
Early type reservoir is shown in the illustration

SERVICING PROCEDURES

9.11 Secondary Regulators Check and Reset Pressure Output



Note:
Early type regulators are shown in the illustration

1. Turn the Gas Delivery Switch to OFF.
2. Disconnect all pipeline and cylinder supplies
3. Remove the front cover - see section 9.6.
   Retighten the screws securing the gas blocks.
   Reconnect the cylinder and pipeline supplies.
4. Attach a pressure gauge to the oxygen regulator test point (1).
   (Early type regulators shown in illustration)
5. Turn the Gas Delivery Switch to ON.
6. Set a flow of 5 L/min Oxygen.
   Reset the Oxygen secondary regulator to the figure given in the table.
7. To increase output: turn the regulator cap, (2) slowly clockwise.
   To decrease output: turn the regulator cap fully anti-clockwise, then clockwise to the correct setting.
8. Return the flow to minimum.
9. Attach a pressure gauge to the nitrous oxide regulator test point (3).
10. Set a flow of 5 L/min nitrous oxide.
    Reset the N_2O secondary regulator to the figure given in the table.
    To increase output: turn the regulator cap, (4) slowly clockwise.
    To decrease output: turn the regulator cap fully anti-clockwise, then clockwise to the correct setting.
    Return the flow to minimum.
11. Turn the Gas Delivery Switch to OFF.
12. Check the oxygen basal flow - see section 9.8.1.
13. Check % oxygen concentration. - see section 9.8.2.

Secondary regulators
Pressure output at 5 L/min flow

Machines built from March 2002 onwards

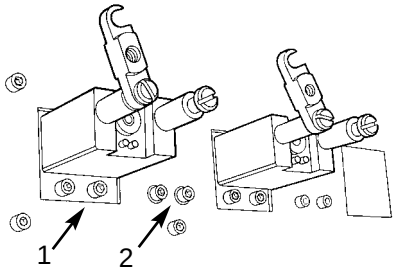
Oxygen and Nitrous Oxide	152 - 241 kPa	(22 - 35 psi)
Air	207 - 283 kPa	(30 - 41 psi)

Machines built before March 2002

All gases	207 - 283 kPa	(30 - 41 psi)

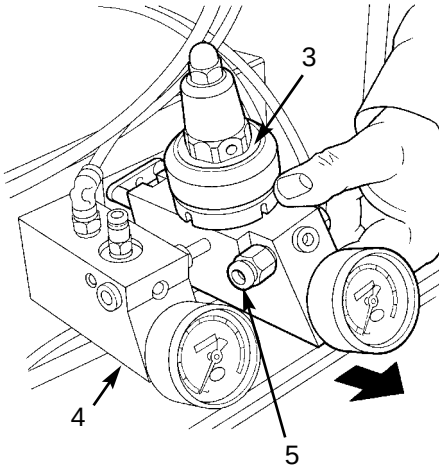
SERVICING PROCEDURES

9.12 High Pressure (Cylinder) Gas Block Remove and Refit



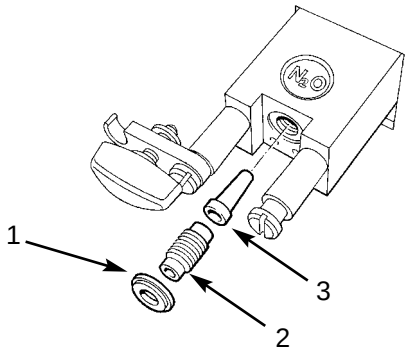
CAUTION
Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

1. Remove all cylinders and disconnect all pipeline supplies.
2. At the rear of the machine, remove the two screws (1) at the rear of the block to be removed.
   Refer to 9.6.2 if necessary.
3. Remove the screws (2) at the rear of the adjacent gas block.
4. At the front of the machine, carefully pull the blocks (3 and 4) from the machine.
   Separate the blocks - detach the block (4) from the tubing connector (5).
5. To refit. reverse the above procedure and then carry out a full function test (see section 6).



Yoke Filter - Remove and Refit

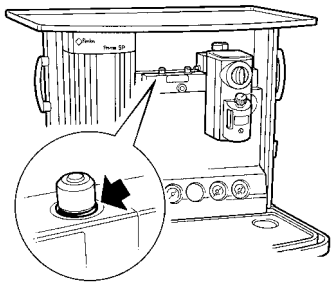
CAUTION
Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.



1. Remove all cylinders and disconnect all pipeline supplies.
2. remove the Bodok seal (1).
3. Unscrew the yoke insert (2).
4. Use a suitable rod to carefully remove the filter (3).
5. To refit. reverse the above procedure. Fit a new Bodok seal.
   Function test the machine (see section 6).

SERVICING PROCEDURES

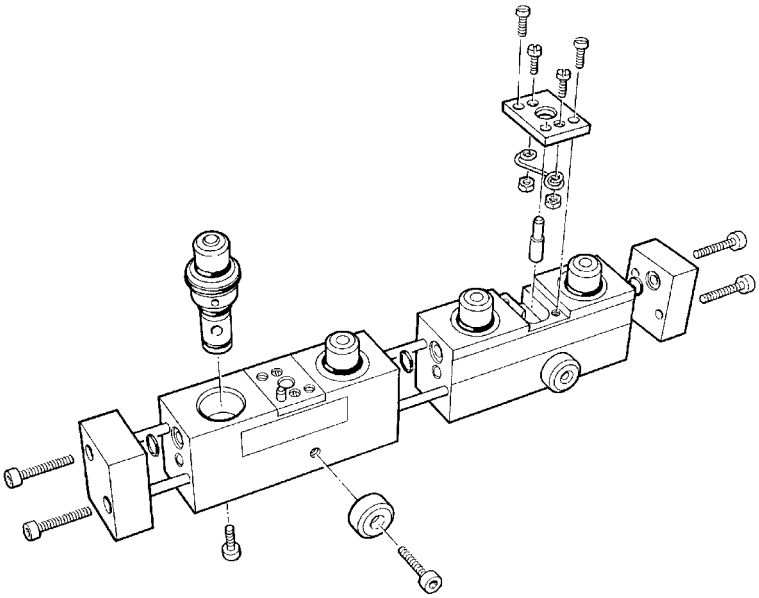
9.13 Selectatec Compatible Manifold Block



1. The valve capsule top O-seal (arrowed on the illustration) must be regularly changed to prevent the possible occurrence of leaking Check for splitting, perishing, and expansion, and also check if the seal is sticking to the vaporizer.

To ensure satisfactory performance:

a. ALWAYS perform a leak test before using the manifold block or after changing the vaporizer.
b. Replace these O-seals regularly (maximum 6 months interval).
   DO NOT apply grease or lubricant



Overhaul

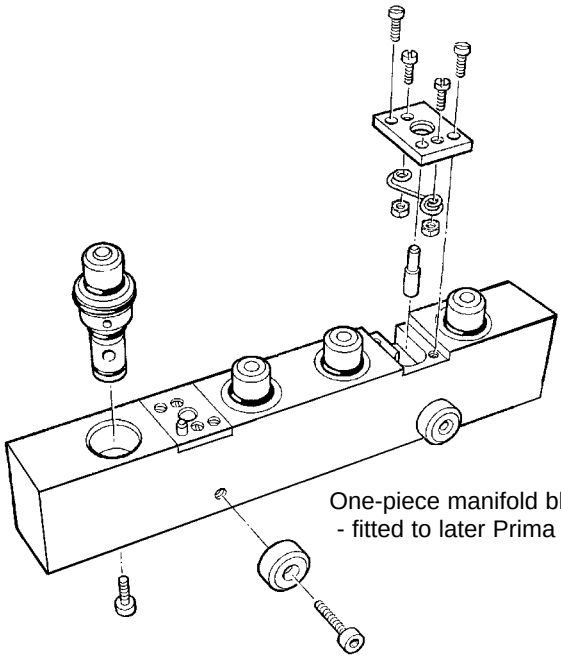
CAUTION *Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.*

Removal

1. Remove all cylinders and disconnect all pipeline supplies.
2. Remove the front cover, (see section 9.6), to gain access to the manifold block.
3. Disconnect the inlet and outlet fresh gas hoses.
4. Remove the screws at the rear of the machine, to allow removal of the manifold block.

Overhaul and Refit

5. Dismantle the block as illustrated. Note that later Prima SP models are fitted with a one-piece manifold block assembly.
6. Renew all O-seals.
7. To refit. reverse the dismantling procedure.
   Function test the machine - see section 6.



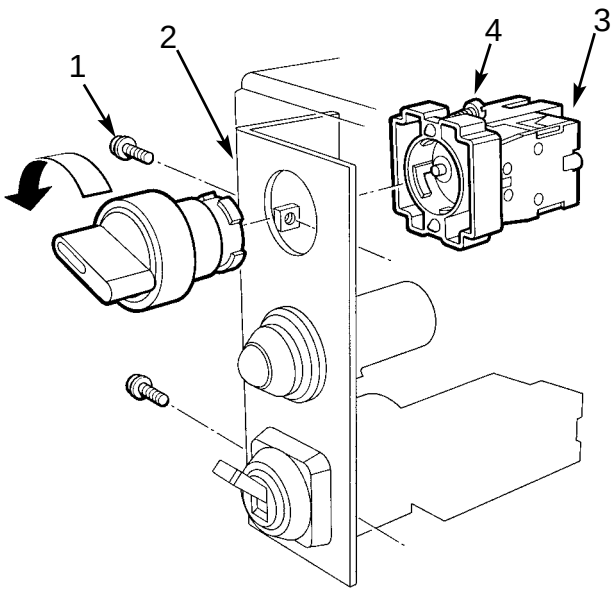
One-piece manifold block
- fitted to later Prima SP models

9.14 Gas Delivery Switch

CAUTION

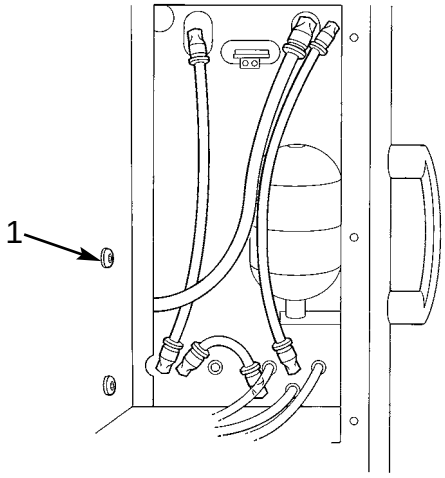
Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

1. Remove all cylinders and disconnect all pipeline supplies.
2. Remove the front cover (see 9.6).
3. Remove the cover at the back of the machine
4. Remove the screws (1) to release the switch mounting bracket (2).
5. Disconnect the tubing from the rear of the switch assembly (3).
6. Slacken the screws (4).
7. Twist the front of the switch, as illustrated, to unlock the two halves of the switch assembly.



Refitting

8. Reverse the removal procedure.
   Fit the front cover - see section 9.6.
   Carry out a Function test, section 6.

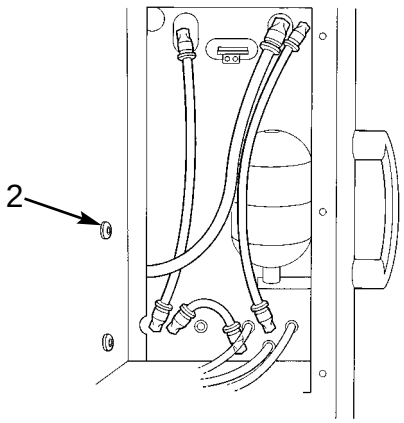


SERVICING PROCEDURES

9.15 Air/N_2O Interlock Switch

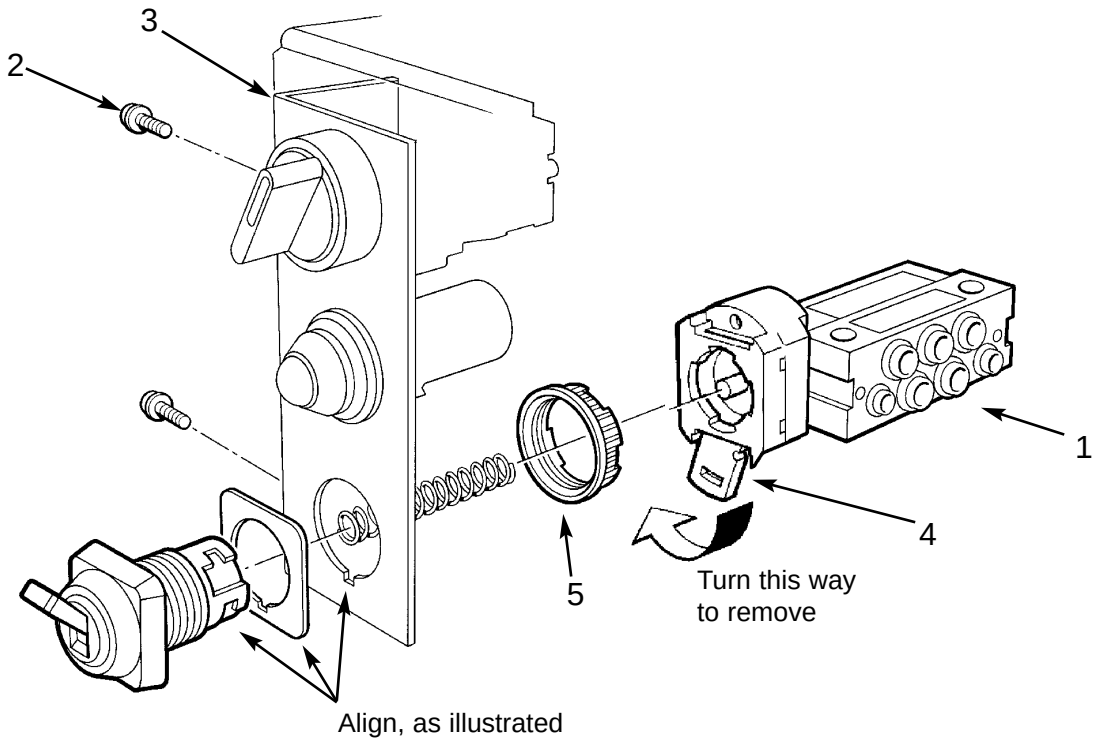
CAUTION
Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

1. Remove all cylinders and disconnect all pipeline supplies.
2. Remove the front cover (see 9.6).
3. Disconnect the tubing from the switch assembly (1).
4. Remove the cover at the back of the machine
5. Remove the screws (2) to release the switch mounting bracket (3).
6. Turn the lever (4) clockwise to unlock the two halves of the switch assembly.
7. Unscrew the locking ring (5), and detach the toggle switch (6).



Refitting

8. Reverse the removal procedure.
   Align the toggle switch (6) as illustrated.
   Fit the front cover - see section 9.6.
   Carry out a Function Test, section 6.



SERVICING PROCEDURES

9.16 Oxygen Failure Visual Indicator

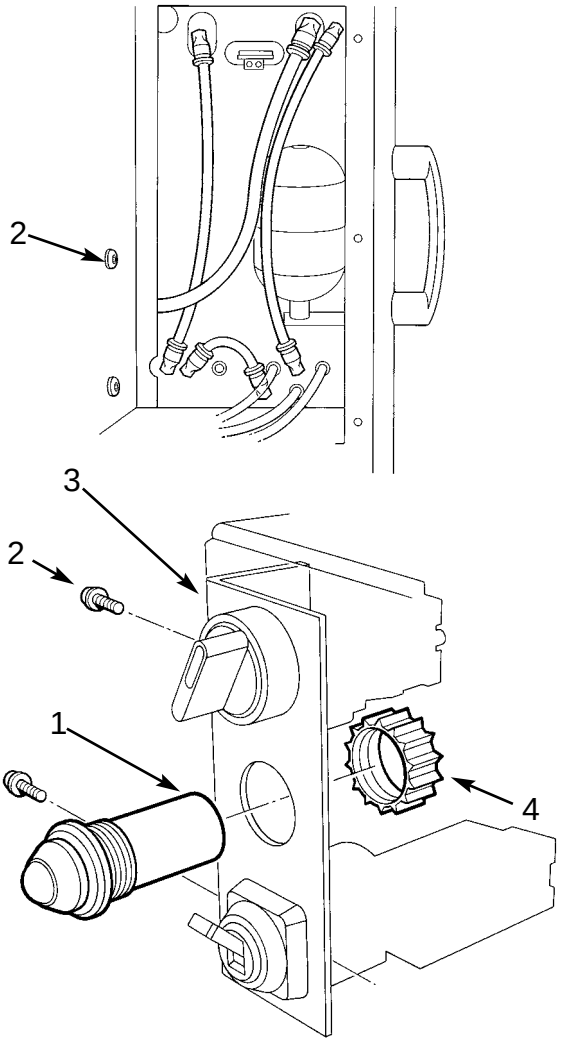
CAUTION
Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

Removal

1. Remove all cylinders and disconnect all pipeline supplies.
2. Remove the front cover (see 9.6).
3. Disconnect the tubing at the rear of the visual indicator (1).
4. Remove the cover at the back of the machine
5. Remove the screws (2) to release the switch mounting bracket (3).
6. Unscrew the locking ring (4), and detach the visual indicator

Refitting

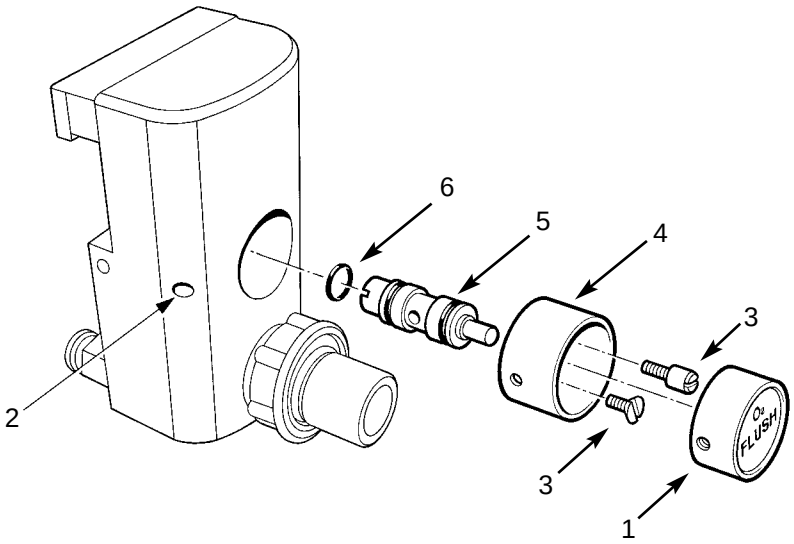
8. Reverse the removal procedure.
   Fit the front cover - see section 9.6.
   Carry out a Function test, section 6.



SERVICING PROCEDURES

9.17 CGO Block - Clippard Valve Replacement

CAUTION
Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.



Removal

1. Remove all cylinders and disconnect all pipeline supplies.
2. Depress the button (1) to allow access at (2) to the grubscrew that retains the button.
3. Slacken the grubscrew, using a M1.3 Allen key, and gently prise out the button.
4. Remove the two screws (3), and withdraw the shield (4), valve (5) and O seal (6).

Refitting

5. Lightly coat the seal (6) with Fomblin.
6. Reverse the removal sequence.
   Carefully refit the Clippard Valve (5) to prevent damage to the seals.
   Check that the countersunk screw and locating screw (3) are fitted in the correct orientation, as illustrated
7 Carry out a machine function check - section 6.

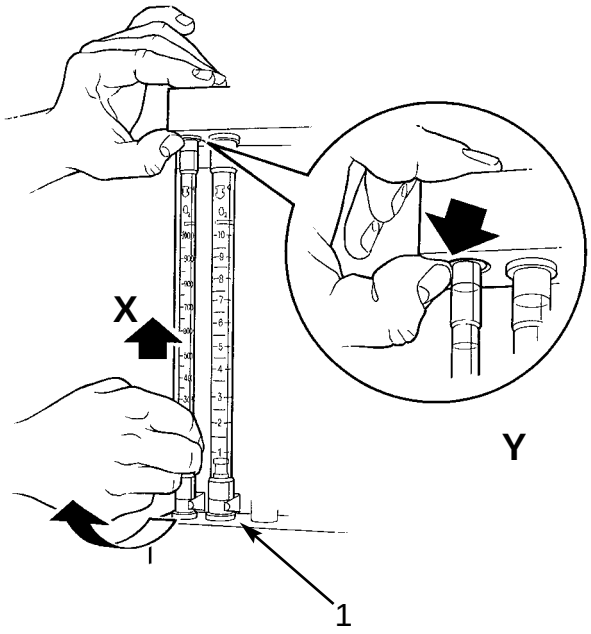
SERVICING PROCEDURES

9.18 Flowmeter Tubes - Removal

CAUTION *Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.*

Removal

1. Remove all cylinders and disconnect all pipeline supplies.
2. Remove the flowmeter cover, (see section 9.7).
3. Hold the tube, as illustrated, and press upwards (X) against the resistance of the spring.
4. Carefully detach the lower end of the tube from the bobbin.
5. Remove the tube, ensuring that the top bobbin remains in place (Y).

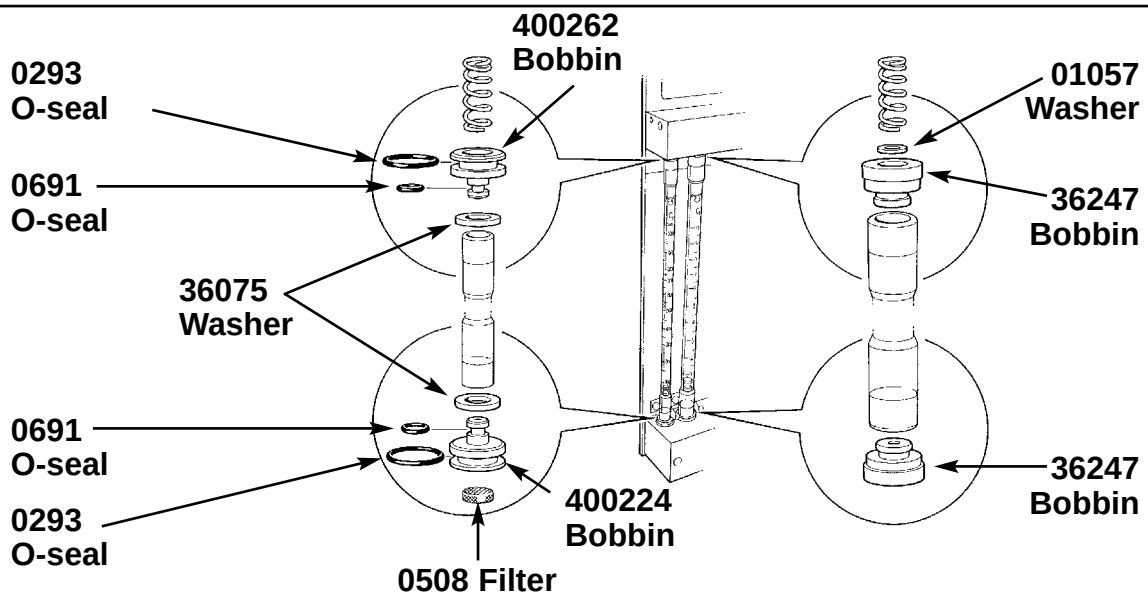


Overhaul - Bobbin Assemblies

6. Remove and refit the components, as illustrated below, taking care not to damage the O-seals when refitting the bobbins.

Refitting the Flowmeter

7. Reverse the removal procedure, noting:
   a) the scale must be centralised.
   b) the tube is touching the contact strip (1).
8. Carry out a machine Function Test - section 6.



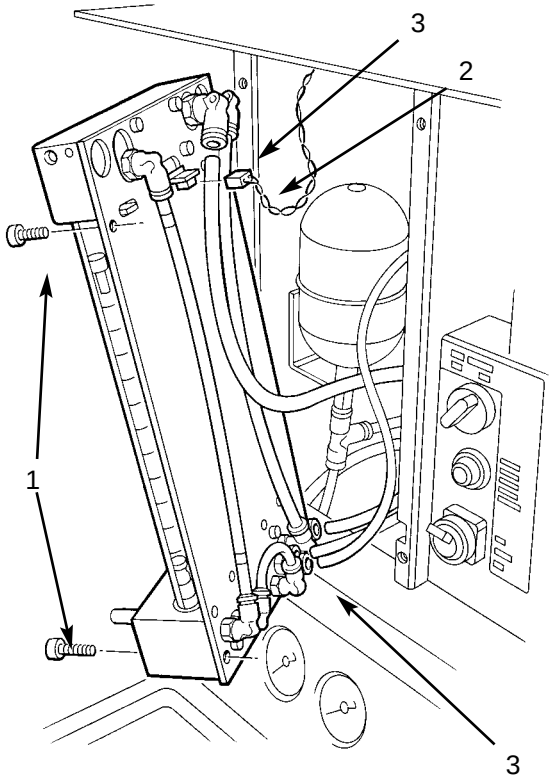
Cascade flowmeter system illustrated. On non-cascade models, a filter (0508) is fitted to each flow tube.

SERVICING PROCEDURES

9.19 Flowmeter Assembly - Removal

CAUTION

Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.



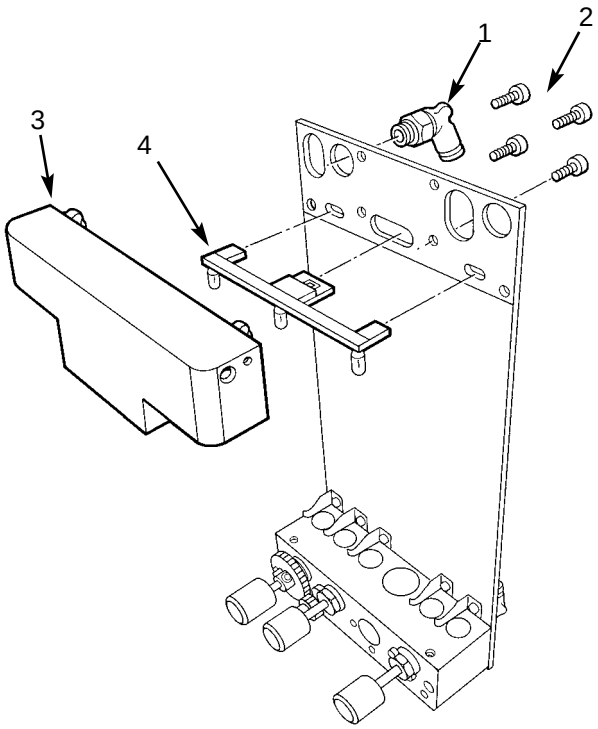
Removal

1. Remove all cylinders and disconnect all pipeline supplies.
2. Disconnect the machine from the mains electrical supply (if necessary).
3. Remove the flowmeter cover, (see section 9.7).
4. Remove the four screws (1) securing the flowmeter assembly to the machine frame.
5. Disconnect the wiring connector (2) - machines with flowbank lighting only.
6. Disconnect the tubing (3) where necessary to allow the removal of the flowmeter assembly.

Refitting

7. Reconnect the tubing at the back of the flowmeter assembly - see section 9.5.
8. Reverse the removal procedure.
9. Carry out a machine Function Test - section 6.

9.20 Flowmeter Lighting - Removal



CAUTION

Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

Removal

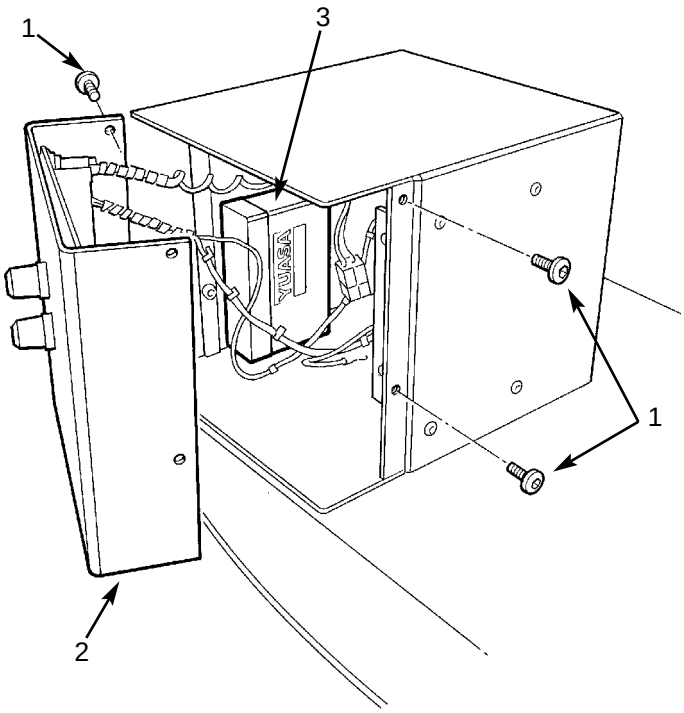
1. Remove all cylinders and disconnect all pipeline supplies.
2. Disconnect the machine from the mains electrical supply.
3. Remove the flowmeter cover, (see section 9.7).
4. Remove the flowmeter tubes and flowmeter assembly (see sections 9.18 and 9.19).
5. Disconnect the tubing connector (1).
6. Remove the three screws (2), and detach the manifold (3).
7. Remove the lighting assembly (4).

Refitting

8. Reverse the removal procedure. Refer to section 9.5 for tubing connections.
9. Carry out a machine Function Test, see section 6.

SERVICING PROCEDURES

9.21 Oxygen Monitor - Battery Replacement



Removal

1. Disconnect the machine from the mains electrical supply.
2. Remove the four screws (1).
3. Carefully detach the front cover assembly (2), to allow access to the battery (3).
4. The battery is attached to the side panel with an adhesive pad.
   Disconnect the battery wiring and detach the battery and pad.

Refitting

5. Reverse the removal procedure.
   Carry out a machine function test - section 6.

SERVICING PROCEDURES

9.22 Oxygen Monitor Sensor.

Sensor - Cleaning and Disinfection

CAUTION
*If you use ethylene oxide for sterilisation, use only a **low** temperature ethylene oxide method. Do **not** immerse the sensor in any cleaning solution.*
*Do **not** autoclave or expose the sensor to high temperatures.*

Sensor Replacement

WARNING
The sensor contains:
a) A small quantity of electrolyte, classified as a harmful irritant which is potentially hazardous.
b) Lead
Do not attempt to open a cell.
ALWAYS check the integrity of the sensor assembly before use.
Once exhausted, the sensor must be disposed of according to hospital, local, state and federal regulations.

Sensor Expiry Date

The approximate expiry date is marked on the sensor label, using two boxes which represent the year and month.
Thus, for a sensor marked as below, the approximate expiry date is end of December 2004.

YR 0 1 2 3 4 5 6 7 8 9

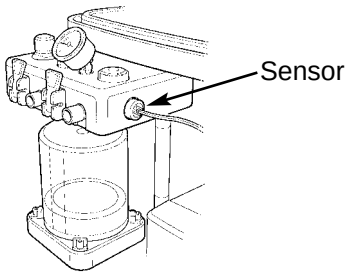
MTH J F M A M J J A S O N D

Sensor Unit - Remove and Refit

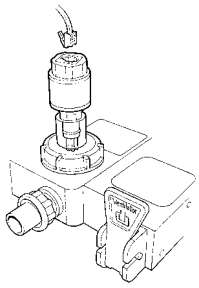
1. Pull out the cable connector (A) from the expired sensor (B).
2. Remove sensor from the absorber or Tee adaptor.
3. Discard the expired sensor and flow diverter (C).
4. Insert the cable connector into the new sensor (B).
5. Screw the new flow diverter (C) onto the new sensor, and fit new O rings.
6. Fit the assembly into the Tee adaptor or absorber.
7. Reconnect the cable
8. Calibrate the new sensor, see section 5.12.
9. Dispose of the used components according to hospital regulations and relevant national legislation.

Oxygen Sensor Location

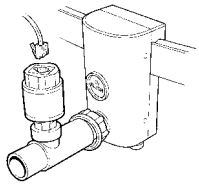
1. Prima SP with A100SP Absorber

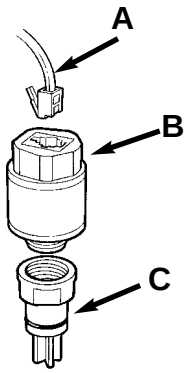


2. Mounted on the dome of the absorber inspiratory valve



3. 'T' piece adaptor on CGO block





Replacement parts

102714	Sensor (B) (includes flow diverter (C) and O rings)
58779	Tee adaptor (CGO fitting)

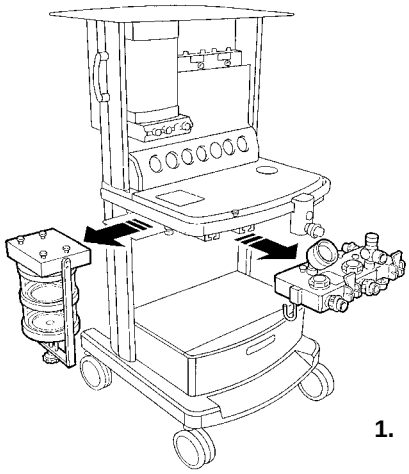
SERVICING PROCEDURES

9.23 A100 Circle System Absorber

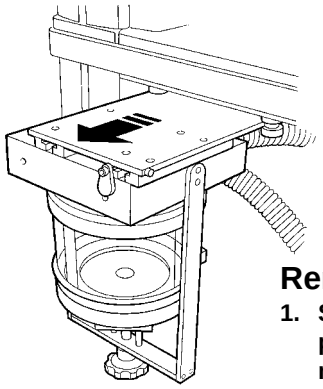
Follow the user maintenance procedures and service recommendations detailed in the A100 circle absorber user instruction manual.

Note
For A100SP Absorber, see Appendix 4

Inboard Mounting System on Prima SP- access to the Canister and Valve Block

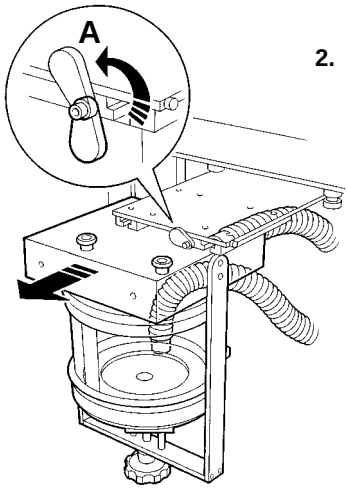


Absorber Canister



Remove

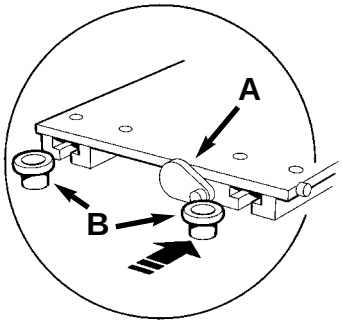
1. **Slide the canister and support plate out from the machine.**



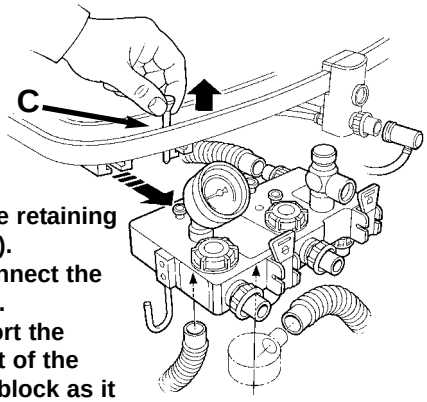
2. **Disconnect the hoses. Rotate the retainer (A), and support the canister as it is removed from the machine.**

Refit

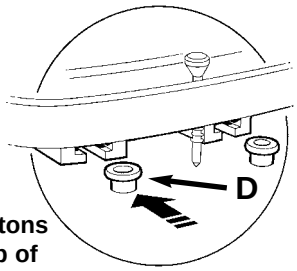
1. **Align the buttons (B) on the top of the canister block with the slots in the support plate.**
2. **Slide the canister into the support plate, and rotate the retainer (A) to lock the canister in position.**
3. **Reconnect the hoses (see 5.6.4), Slide the canister and support plate under the machine work surface.**



Absorber Valve Block Assembly Removal



1. **Lift the retaining pin (C). Disconnect the hoses. Support the weight of the valve block as it is removed from the machine.**



Refit

1. **Align the buttons (D) on the top of the canister block with the slots (E).**
2. **Slide the canister into the support plate.**
3. **Reconnect the hoses (see 5.6.4).**
4. **Fit the retaining pin (C).**

10. PARTS LIST

Prima SP System - Preventive Maintenance Kits

Part No.	Description
Prima SP Mechanical AHD and Selectatec	
57455	6 month
57476	12 month
57479	24 month
57476	36 month
57479	48 month
57476	60 month
57490	72 month
Prima SP Mechanical AHD and Cagemount Backbar	
57455	6 month
58614	12 month
57480	24 month
58614	36 month
57480	48 month
58614	60 month
57489	72 month
A100 Absorber	
58615	12 month
58609	60 month
AV900 Ventilator	
57453	12 month
57453	24 month
57453	36 month
57453	48 month
57454	60 month
AV800 Ventilator	
57633	12 month
57633	24 month
57633	36 month
57633	48 month
57635	60 month
Nuffield 200 Ventilator	
57139	12 month
57139	24 month
57139	36 month
57139	48 month
57450	60 month
Circle System Module	
57451	12 month
57451	24 month
57451	36 month
57451	48 month
57452	60 month

Delta Vaporizer Overhaul Kits

55146	5 year Halothane - Pour Filler
55145	Halothane - Agent Specific (Key) Filler
55144	10 year Enflurane - Pour Filler
55143	10 year Enflurane - Agent Specific (Key) Filler
55142	10 year Isoflurane - Pour Filler
55141	10 year Isoflurane - Agent Specific (Key) Filler
55140	10 year Sevoflurane - Pour Filler
55139	10 year Sevoflurane - Agent Specific (Key) Filler
55147	10 year Sevoflurane - Quik Fil Filler

PARTS LIST

Preventive Maintenance Kit

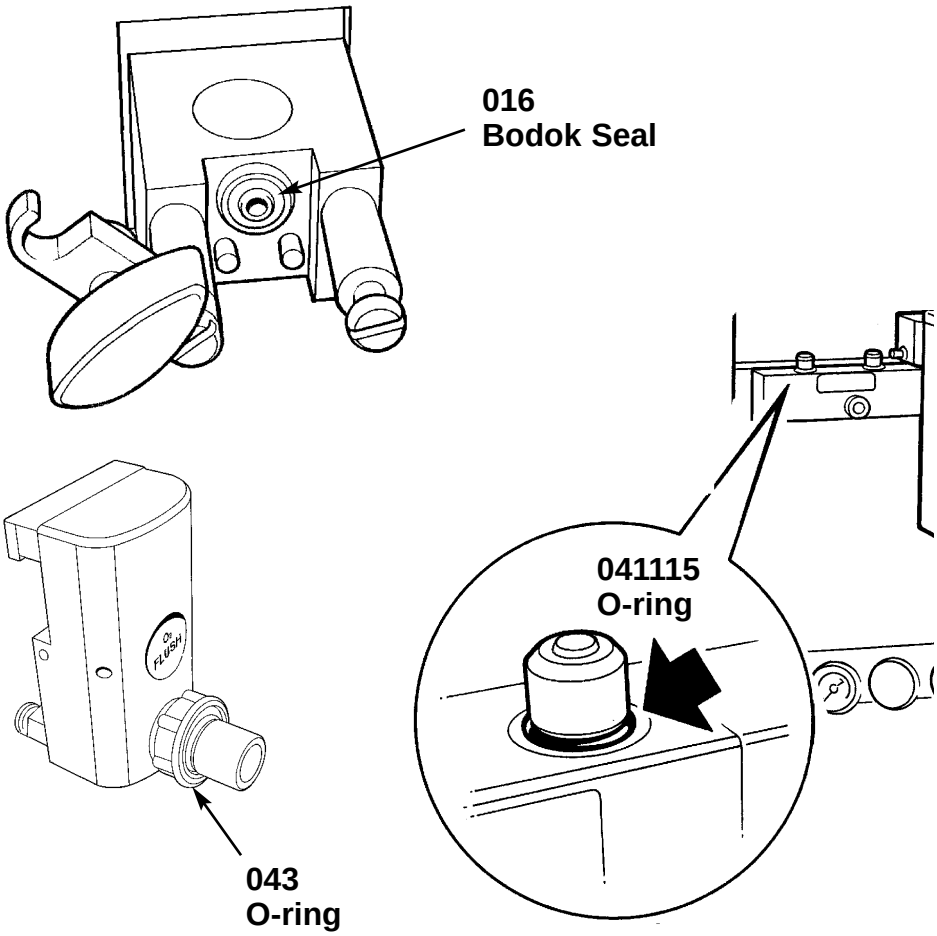
6 Month Service (*use also for UK customer specified 3 month service*)

Part No. 57455

Kit Contents

Part No	*Qty.*	*Component Description*
016	5	Bodok Seal
041115	6	O-ring - Selectatec
043	1	O-ring - Safelock Connector on CGO Block

WARNING ***Do NOT apply grease or lubricant***



PARTS LIST

Cagemount Backbar

Preventive Maintenance Kit

12 / 36 / 60 Month Service

Part No. 58614

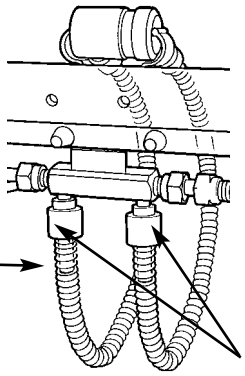
Kit Contents

Part No	*Qty.*	*Component Description*
462526	1.35 m	Hose - Backbar Outlet to CGO *(not shown)*
37946	12	Hose Support
37947	12	Seal Support
37951	12	Split Ring
37950	4	Off-line Hose
016	5	Bodok Seal
0762	8	Filter - Yoke and Pipeline
043	1	O-seal - Safelock
0226	12	O-seal - Hose Assembly
011017	1	Tubing - Sample Block

Do NOT apply grease or lubricant to:

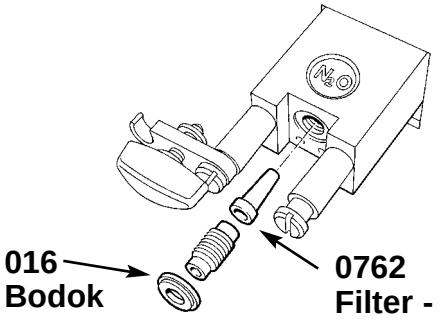
016, Bodok Seal

043, O-seal - Safelock



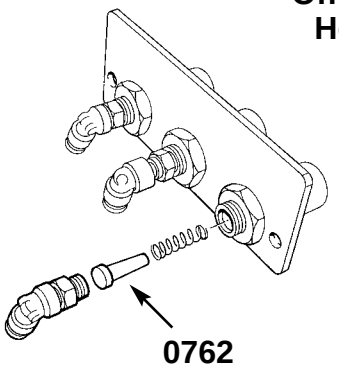
37950 Offline Hose

0226 O-seal Offline Hose

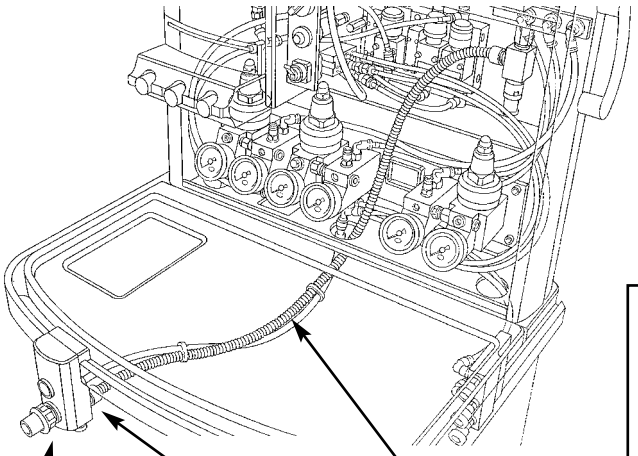


016 Bodok Seal

0762 Filter - Yoke



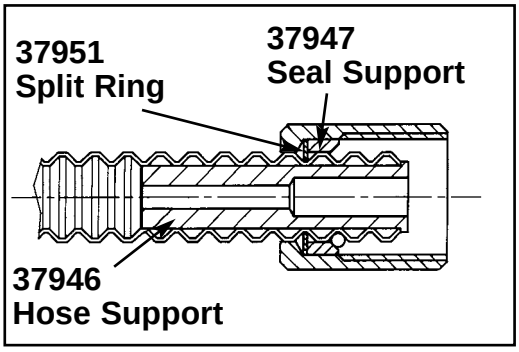
0762 Filter - Pipeline



043 O-seal - Safelock

0226 O-seal

462526 Hose - Backbar to CGO



37951 Split Ring

37947 Seal Support

37946 Hose Support

PARTS LIST

Cagemount Backbar

Preventive Maintenance Kit

24 / 48 Month Service

Part No. 57480

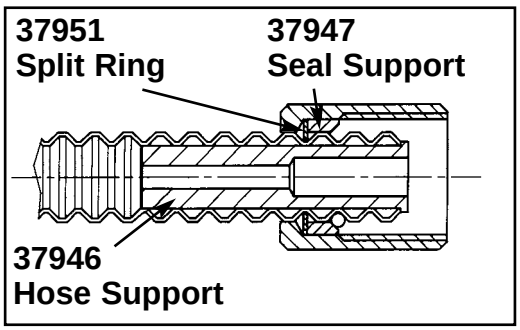
Kit Contents

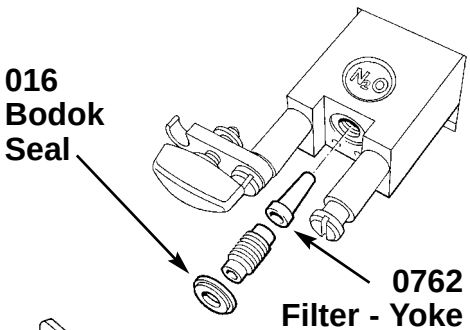
Part No	*Qty.*	*Component Description*
462526	1.35 m	Hose - Backbar Outlet to CGO
37950	4	Off-line Hose
016	5	Bodok Seal
400224	3	Flowmeter Bobbin - Metal with Filter
400262	3	Flowmeter Bobbin - Metal with Filter
0762	8	Filter - Yoke and Pipeline
0508	3	Filter - Flowmeter
36247	6	Flowmeter Bobbin - Tube Seals
01057	3	Washer
36075	6	Shock Washer
0691	6	O-seal - Flowmeter
043	1	O-seal - Safelock
0226	12	O-seal - Hose Assembly
37946	12	Hose Support
37947	12	Seal Support
37951	12	Split O-ring
011017	1	Tubing - Sample Block

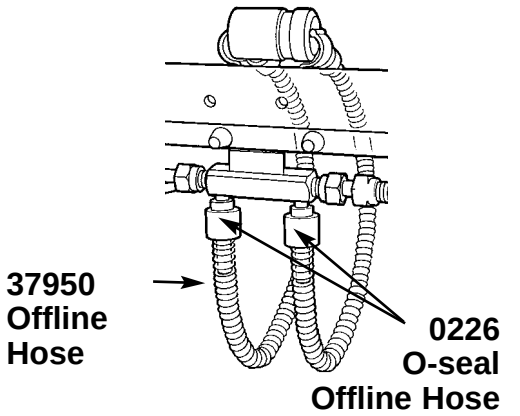
Do NOT apply grease or lubricant to:

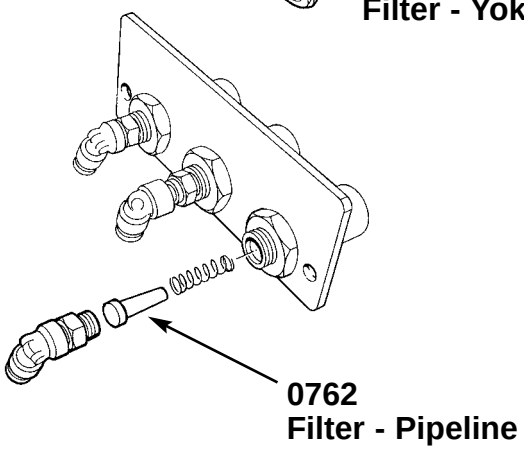
016, Bodok Seal

043, O-seal - Safelock

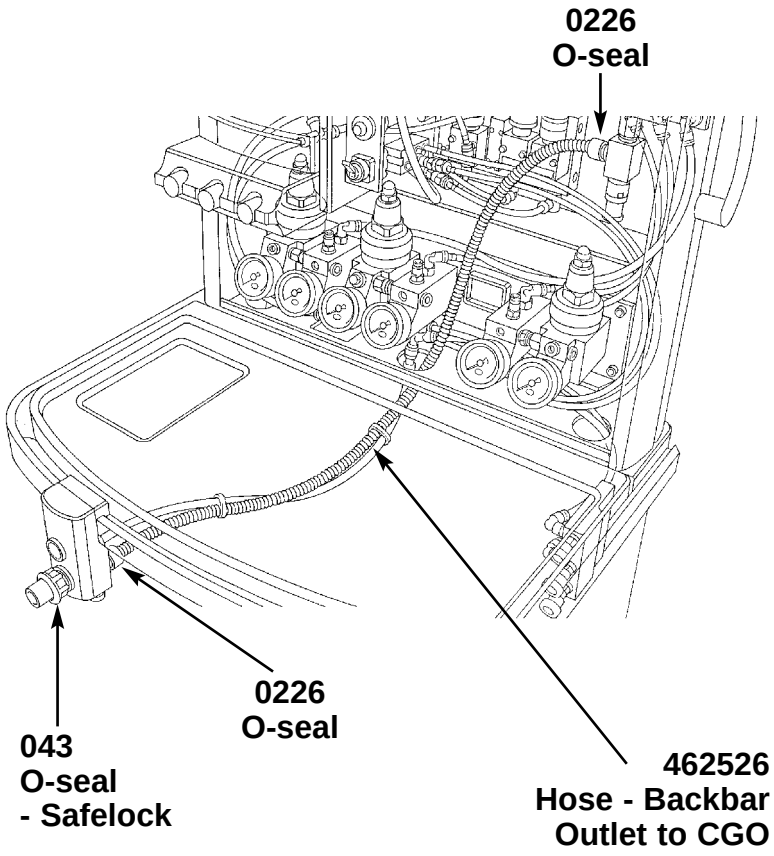


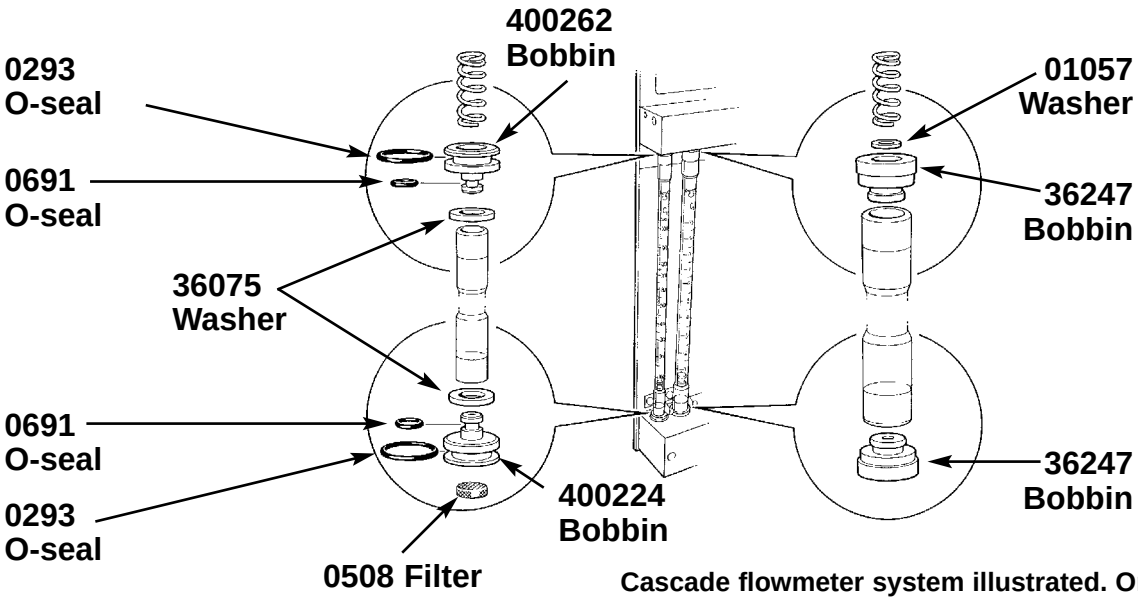






PARTS LIST





Cascade flowmeter system illustrated. On non-cascade models, a filter (0508) is fitted to each flow tube.

PARTS LIST

Cagemount Backbar

Preventive Maintenance Kit

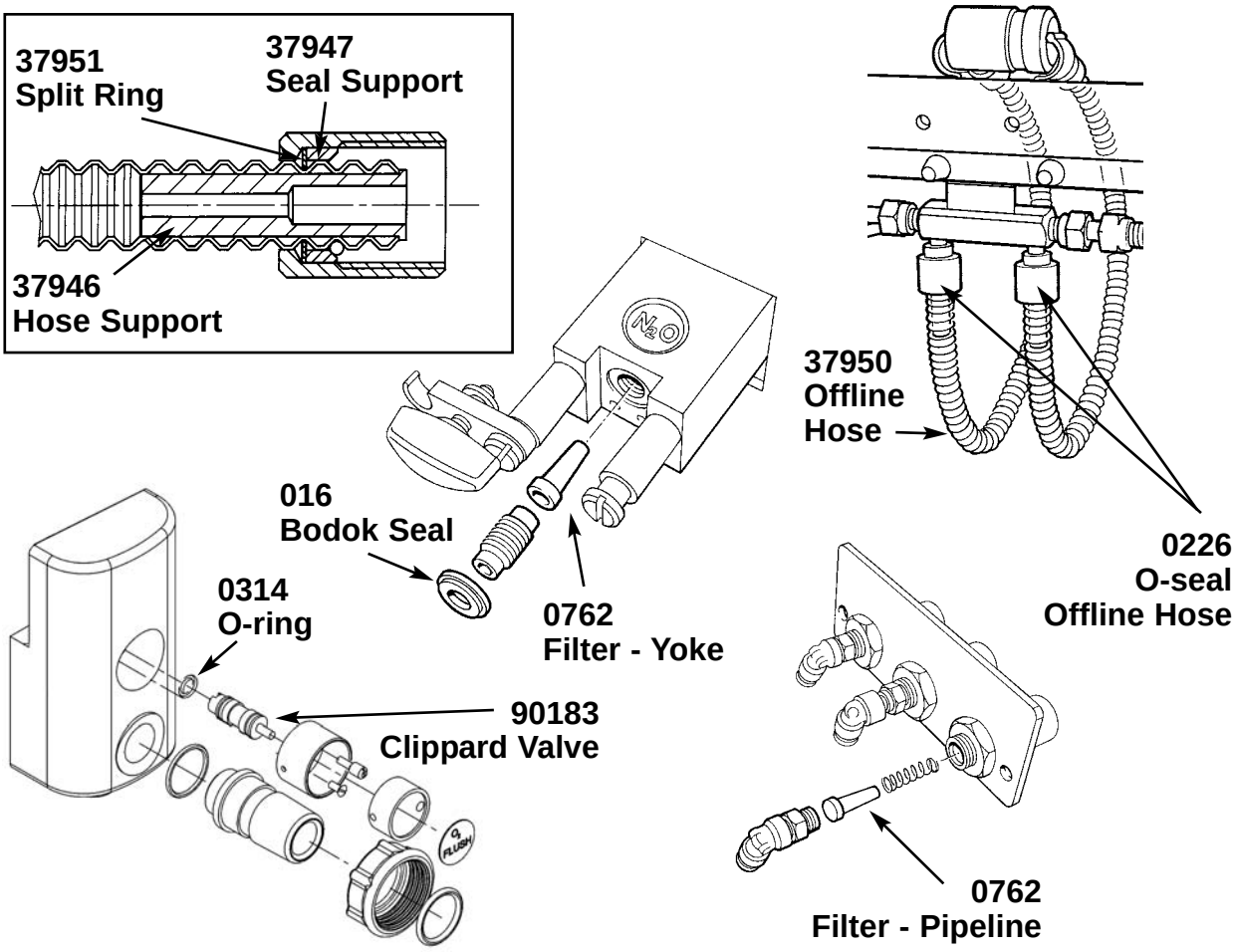
72 Month Service

Part No. 57489

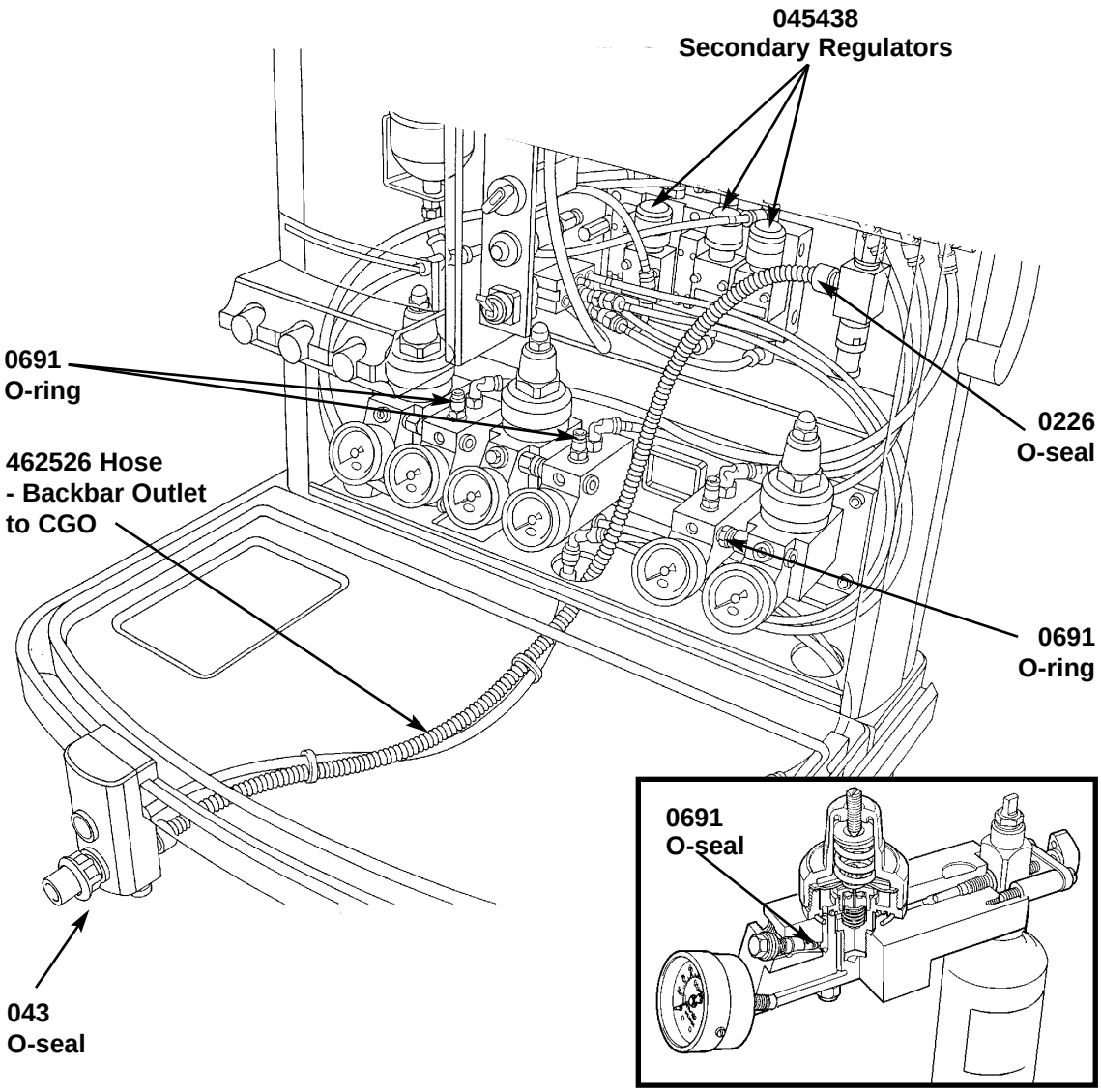
Do NOT apply grease or lubricant to:
016, Bodok Seal
043, O-seal - Safelock

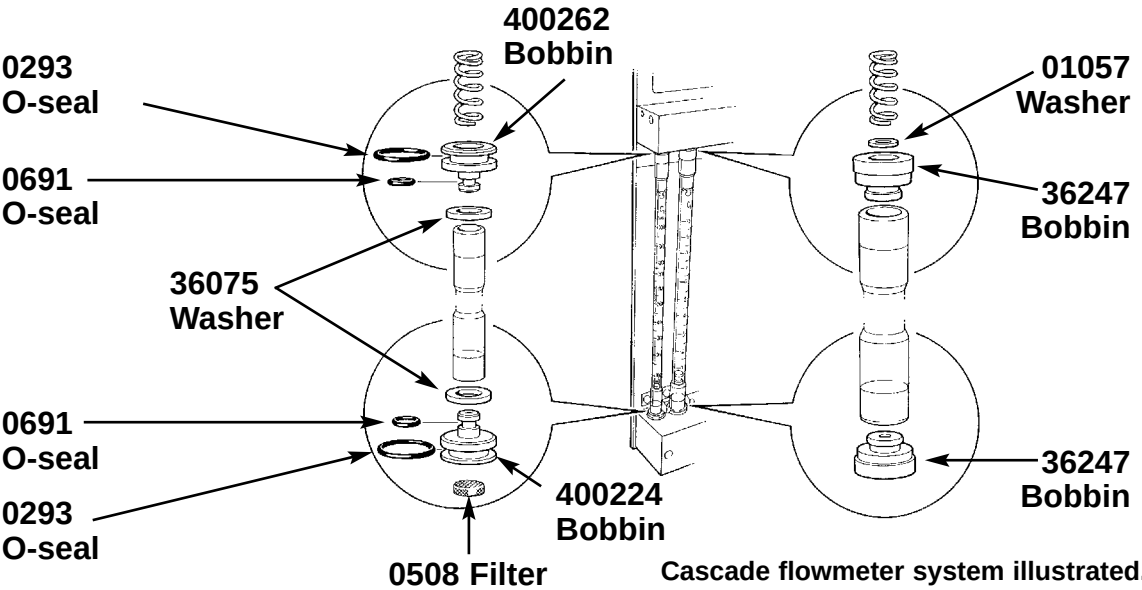
Kit Contents

Part No	*Qty.*	*Component Description*
462526	1.35 m	Hose - Backbar Outlet to CGO
0226	4	O Seal - Hose Assembly
37946	4	Hose Support
37947	4	Seal Support
37951	4	Split Ring
37950	4	Off-Line Hose
016	5	Bodok Seal
400224	3	Flowmeter Bobbin - Metal with Filter
400262	3	Flowmeter Bobbin - Metal without Filter
0762	8	Filter - Yoke and Pipeline
0508	3	Filter - Flowmeter
36247	6	Flowmeter Bobbin - Tube Seals
01057	4	Washer
36075	6	Shock Washer
0691	6	O Seal - Flowmeter
043	1	O Seal - Safelock
011017	1	Tubing - Sample Block
045438	2	Secondary Regulators - Mech AHD
90183	1	Clippard Valve - Oxygen Flush
0314	2	O Ring - Oxygen Flush Clippard Valve
0691	6	O Ring - Cylinder/Pipeline NRV
Following not shown:		
462544	3 m	8 mm Hose - Oxygen - Internal
462543	2 m	6 mm Hose - Nitrous Oxide - Internal
462542	2 m	5 mm Hose - Air - Internal
462541	1 m	4 mm Hose - Switch Feeds/CO_2 - Internal
01089	1strip	Gas ID Label White - Oxygen
011026	1strip	Gas ID Label Blue - Nitrous Oxide
011027	1strip	Gas ID Label Black - Air
011023	1strip	Gas ID Label Grey - Carbon Dioxide



PARTS LIST





Cascade flowmeter system illustrated. On non-cascade models, a filter (0508) is fitted to each flow tube.

PARTS LIST

Selectatec Backbar

Preventive Maintenance Kit

12 / 36 / 60 Month Service

Part No. 57476

Kit Contents

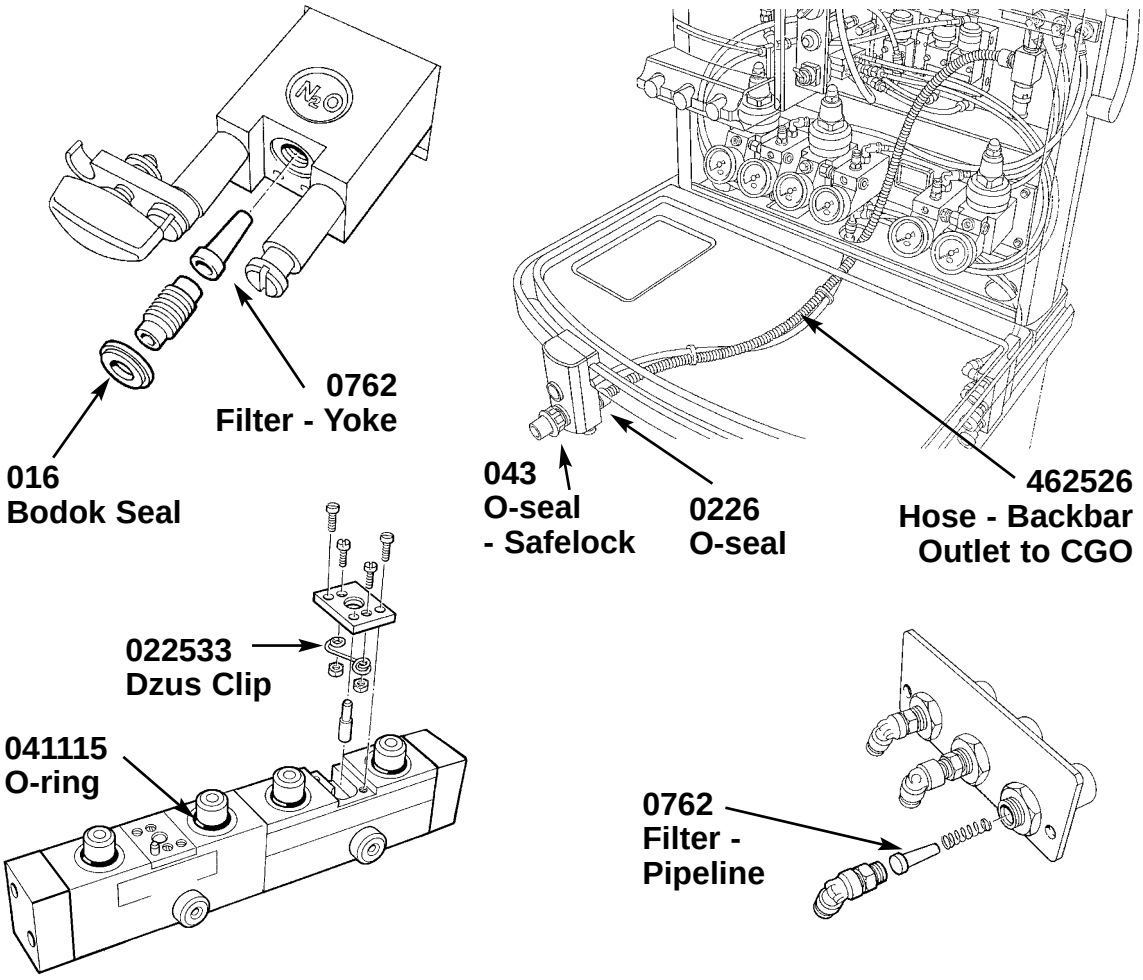
Part No	*Qty.*	*Component Description*
462526	1.35 m	Hose - Backbar Outlet to CGO
37946	4	Hose Support
37947	4	Seal Support
37951	4	Split Ring
022533	2	Dzus Clip
041115	4	O-ring - Selectatec
016	5	Bodok Seal
0762	8	Filter - Yoke and Pipeline
043	1	O-seal - Safelock
011017	1	Tubing - Sample Block

Do NOT apply grease or lubricant to:

016, Bodok Seal

043, O-seal - Safelock

041115, O-ring -Selectatec



PARTS LIST

Selectatec Backbar

Preventive Maintenance Kit

24 / 48 Month Service

Part No. 57479

Kit Contents

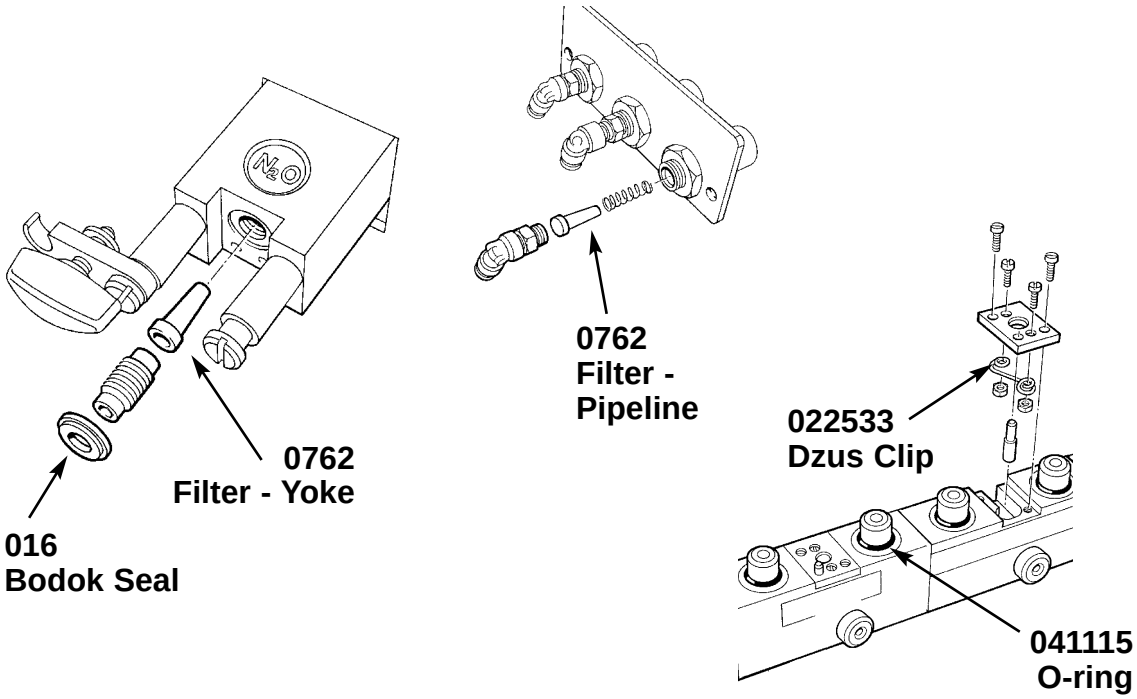
Part No	*Qty.*	*Component Description*
462526	1.35 m	Hose - Backbar Outlet to CGO
37946	4	Hose Support
37947	4	Seal Support
37951	4	Split Ring
041115	4	O-ring - Selectatec
016	5	Bodok Seal
400224	3	Flowmeter Bobbin - Metal with Filter
400262	3	Flowmeter Bobbin - Metal without Filter
0762	8	Filter - Yoke and Pipeline
0508	3	Filter - Flowmeter
36247	6	Flowmeter Bobbin - Tube Seals
01057	3	Washer
36075	6	Shock Washer
0691	6	O-seal - Flowmeter
043	1	O-seal - Safelock
011017	1	Tubing - Sample Block
022533	2	Dzus Clip

Do NOT apply grease or lubricant to:

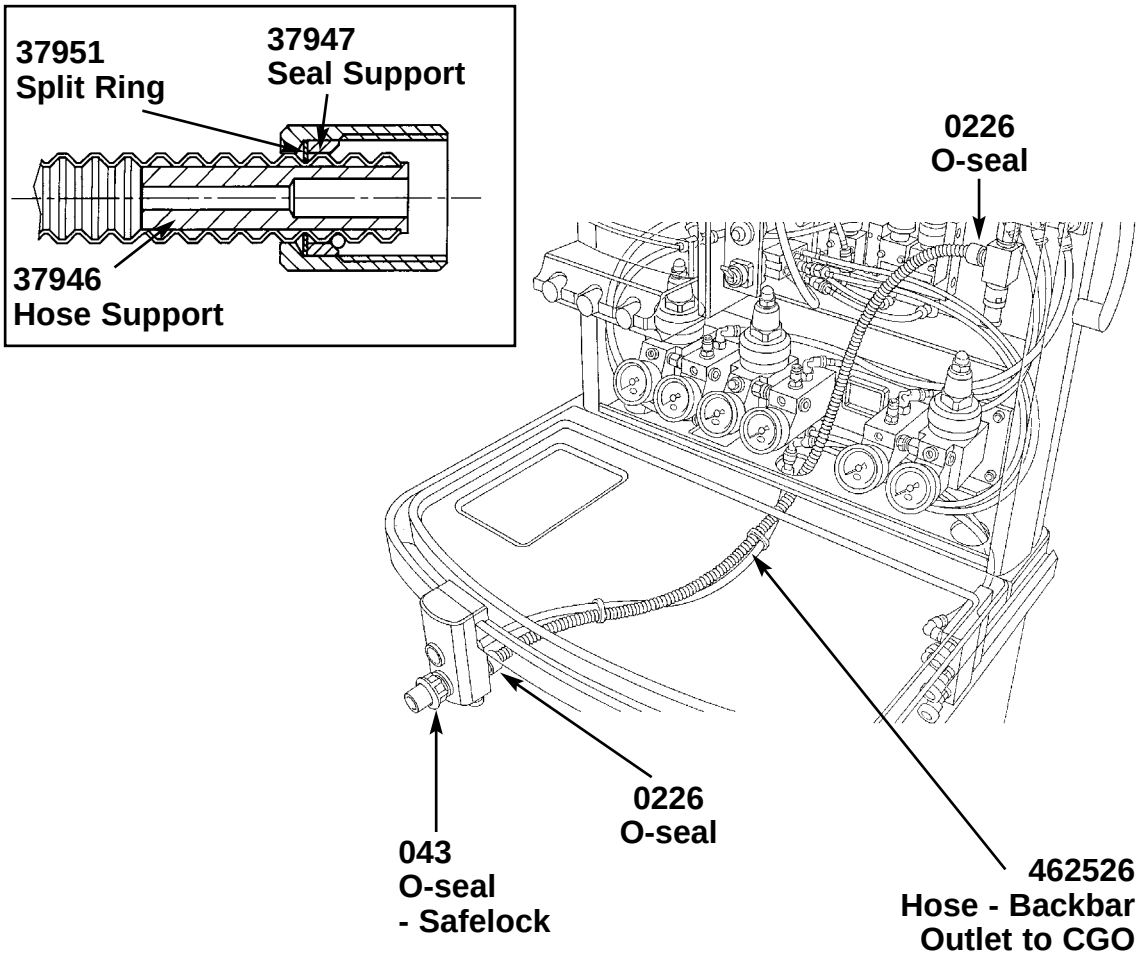
016, Bodok Seal

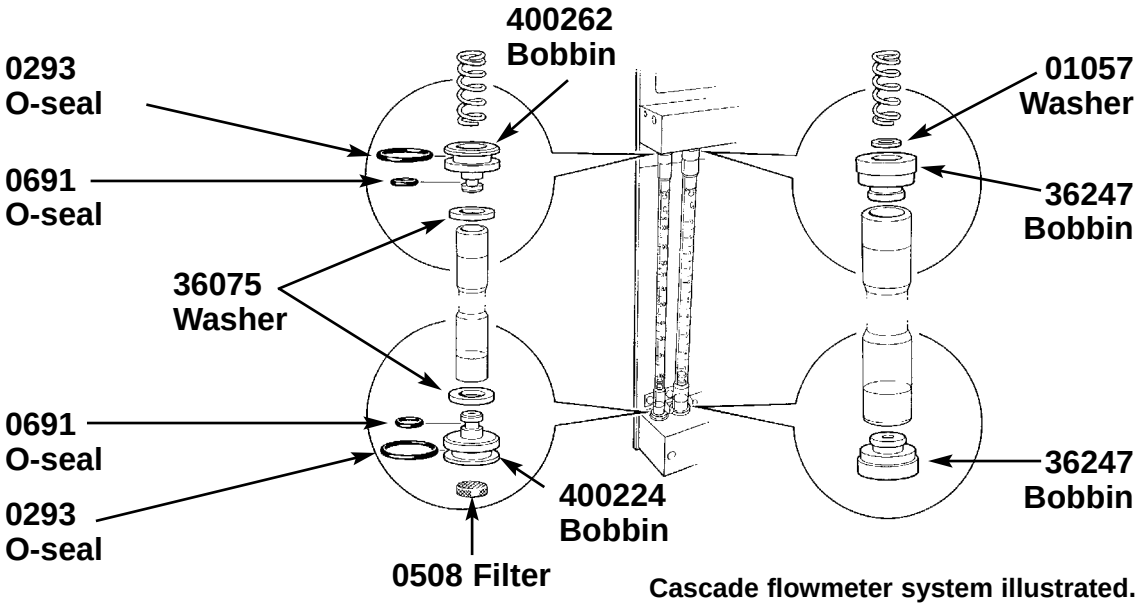
043, O-seal - Safelock

041115, O-ring -Selectatec



PARTS LIST





Cascade flowmeter system illustrated.
On non-cascade models, a filter (0508) is fitted to each flow tube.

PARTS LIST

Mechanical AHD
Selectatec Backbar

Preventive Maintenance Kit

72 Month Service

Part No. 57490

Do NOT apply grease or lubricant to:

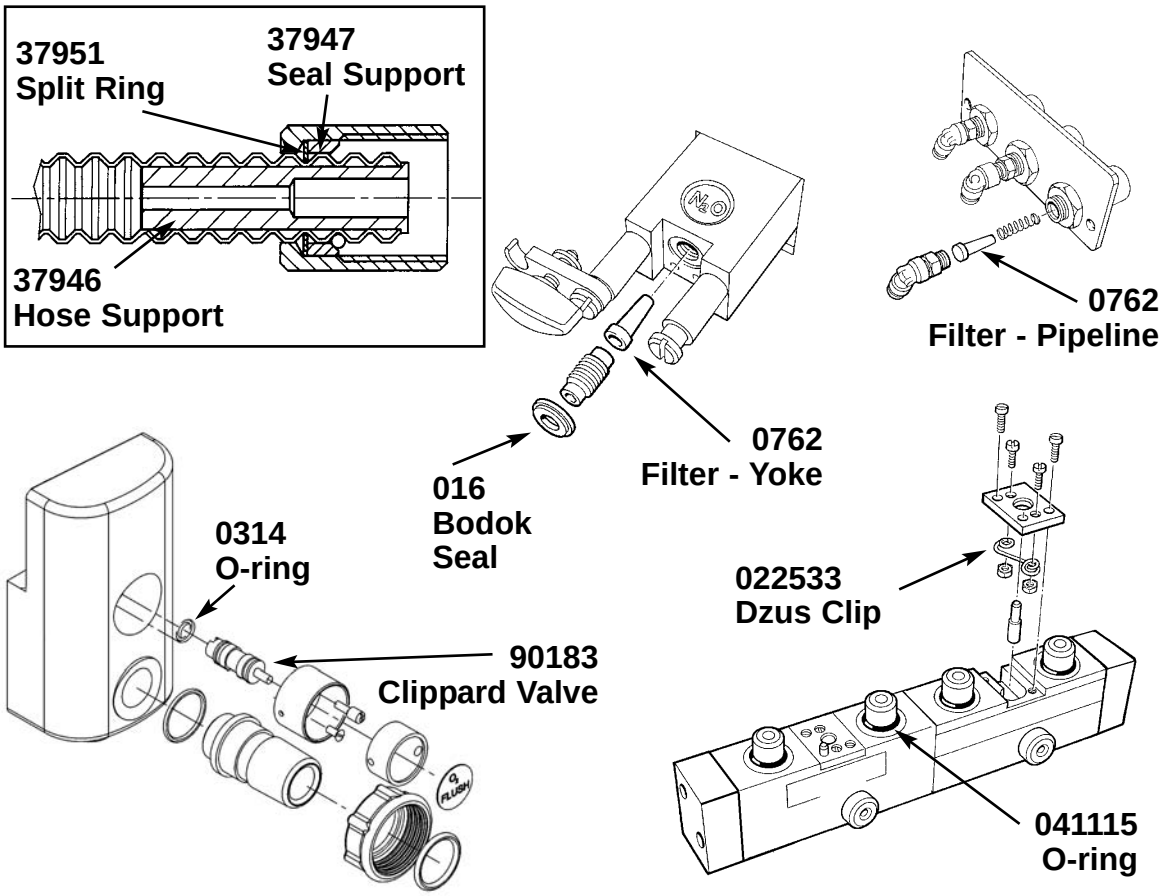
016, Bodok Seal

043, O-seal - Safelock

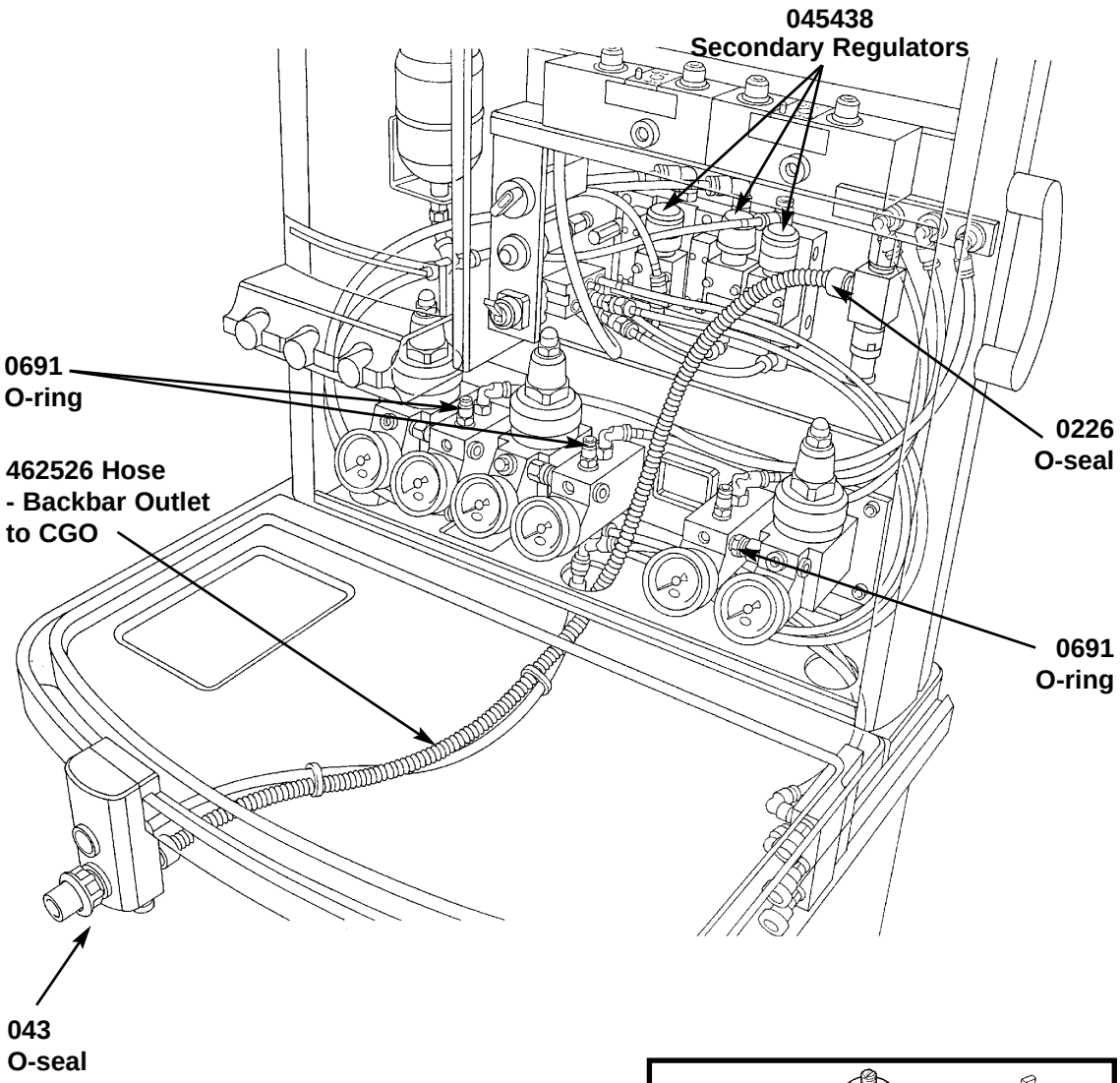
041115, O-ring -Selectatec

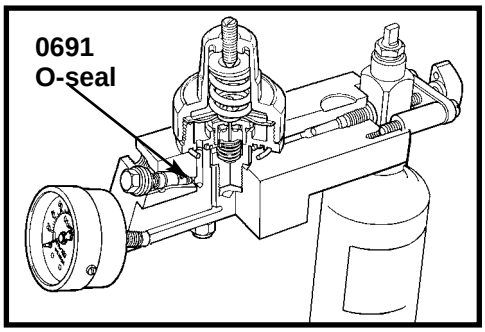
Kit Contents

Part No	*Qty.*	*Component Description*
462526	1.35 m	Hose - Backbar Outlet to CGO
0226	4	O-seal - Fresh Gas Sampling Adapter
041115	4	O-ring - Selectatec
016	5	Bodok Seal
400224	3	Flowmeter Bobbin - Metal with Filter
400262	3	Flowmeter Bobbin - Metal without Filter
0762	8	Filter - Yoke and Pipeline
0508	3	Filter - Flowmeter
36247	6	Flowmeter Bobbin - Tube Seals
01057	4	Washer
36075	6	Shock Washer
0691	6	O-seal - Flowmeter
043	1	O-seal - Safelock
011017	1	Tubing - Sample Block
045438	2	Secondary Regulator - Mech AHD
022533	2	Dzus Clip
90183	1	Clippard Valve - Oxygen Flush
0314	2	O-ring - Oxygen Flush Clippard Valve
0691	6	O-ring - Cylinder/Pipeline NRV
37946	4	Hose Support
37947	4	Seal Support
37951	4	Split Ring
Following not shown:		
462544	3 m	8 mm Hose - Oxygen - Internal
462543	2 m	6 mm Hose - Nitrous Oxide - Internal
462542	2 m	5 mm Hose - Air - Internal
462541	1 m	4 mm Hose - Switch Feeds/CO_2 - Internal
01089	1strip	Gas ID Label White - Oxygen
011026	1strip	Gas ID Label Blue - Nitrous Oxide
011027	1strip	Gas ID Label Black - Air
011023	1strip	Gas ID Label Grey - Carbon Dioxide

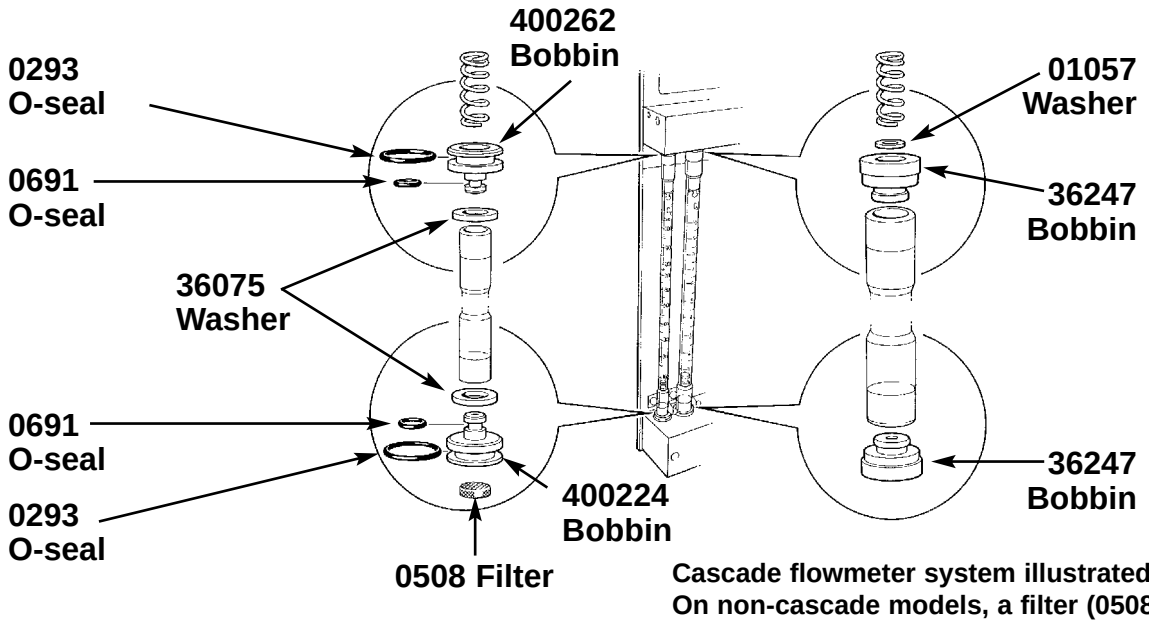


PARTS LIST


045438
Secondary Regulators
0691
O-ring
462526 Hose
- Backbar Outlet
to CGO
043
O-seal
0226
O-seal
0691
O-ring


0691
O-seal

PARTS LIST

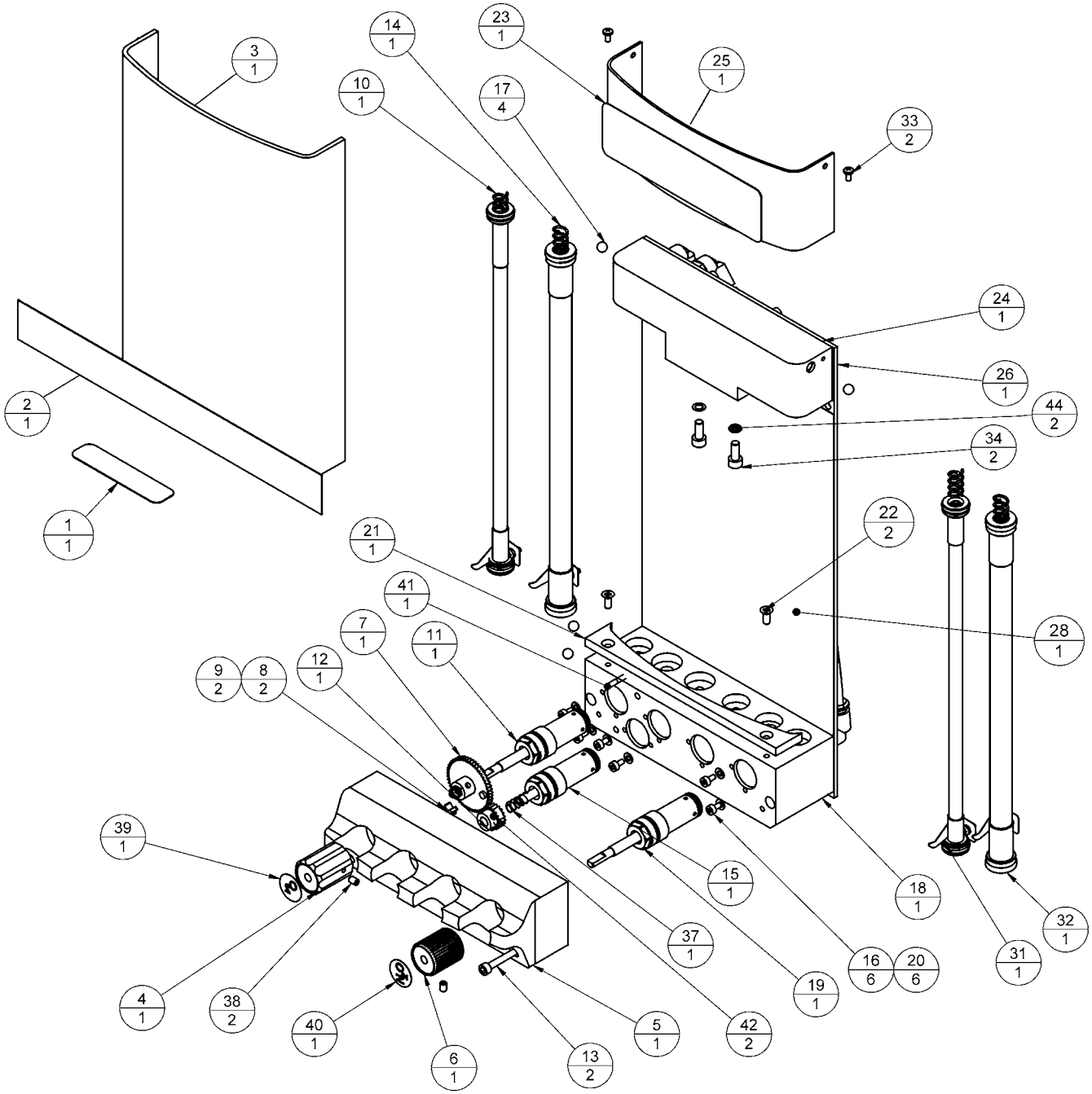


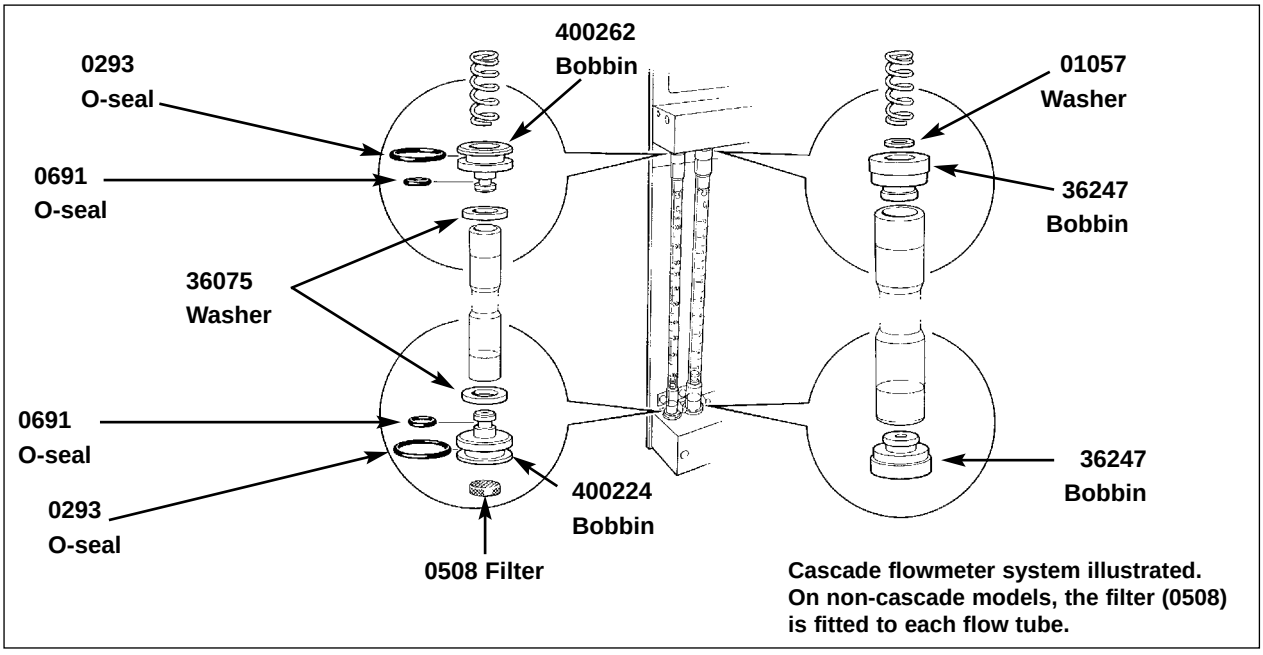
Cascade flowmeter system illustrated. On non-cascade models, a filter (0508) is fitted to each flow tube.

PARTS LIST

Flowmeter Assembly - Two gas Cascade (UK specification)

Ref	Part No.	Description	Qty.
1	14978	Mechanical AHD Label	1
2	800341	Flowmeter Overlay	1
3	800196	Flow Tube Cover	1
4	800231	Knob - O2	1
5	800269	`Anti-tamper' Block	1
6	800230	Knob - N2O, Air, CO2	1
7	015043	Spur Gear (50 Teeth)	1
8	019025	M4 x 8 Grubscrew	2
9	01023	M4 Nut	2
10	800225	Flow Tube, O2 - Low	1
11	38315	Needle Valve, O2 - up to March 2002	1
	800408	Needle Valve, O2 - up to March 2002	1
12	015044	Spur Gear (20 Teeth)	1
13	01031	M4 x 35 Screw (Cap Head St St)	2
14	800223	Flow Tube, O2 - Cascade	1
15	38317	Needle valve capsule, N2O - up to March 2002	1
	800409	Needle valve capsule, N2O - from March 2002	1
16	019011	M3 x 6 Screw (Socket Head)	6
17	0360	Ball - 0.25"	4
18	700362	Manifold Block - Cascade (UK spec)	1
19	38316	Needle Valve	1
20	01067	M3 Plain washer	6
21	800270	Spacer Plate	1
22	019123	Screw, M4 x10 (CSK St. St).	2
23	800239	Label - Prima SP	1
24	700366	Mixing Chamber - Cascade (UK spec)	1
25	800285	Top Cover	1
26	800234	Flowmeter Panel	1
27	054515	Elbow - 8 mm Tube	2
28	402736	Luminescent Panel	1
29	054524	Elbow - 10 mm Tube	1
30	019067	Screw, M4 x 12 SKT HD Cap	8
31	800226	Flow Tube N2O Low	1
32	800222	Flow Tube N2O Cascade	1
33	019133	Screw, M3 x 6	2
34	01056	Screw, M5 x12	2
35	462543-A/R	6 mm Tube	As required
36	054514	Elbow - 6mm Tube	4
37	031048	Spring *(not required on pre-March 2002 models)*	1
38	01027	Grubscrew, M4 x 6	2
39	15252	Label O2 UK	1
40	15277	Label N2O	1
41	38349	Stop Pin	1
42	019083	Grubscrew, M4 x 4	2
44	0770	Selon Seal, 2 BA	2
45	054519	Coupling	1
46	054518	Tube Connector	1
47	462543--A/R	6 mm Tube	As required
48	462544--A/R	8 mm Tube	As required
49	15023	Product Label, including CE Mark	1



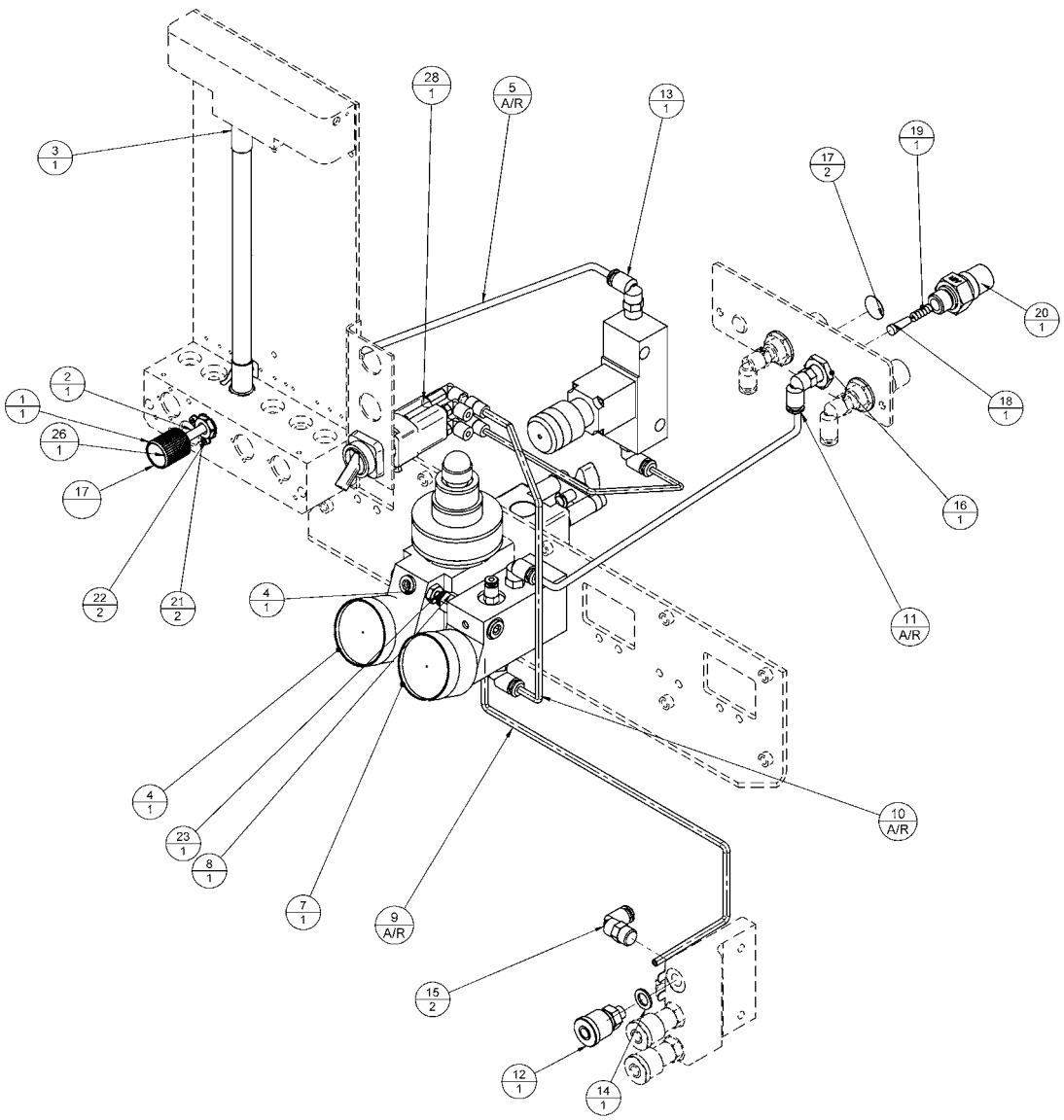


Cascade flowmeter system illustrated. On non-cascade models, the filter (0508) is fitted to each flow tube.

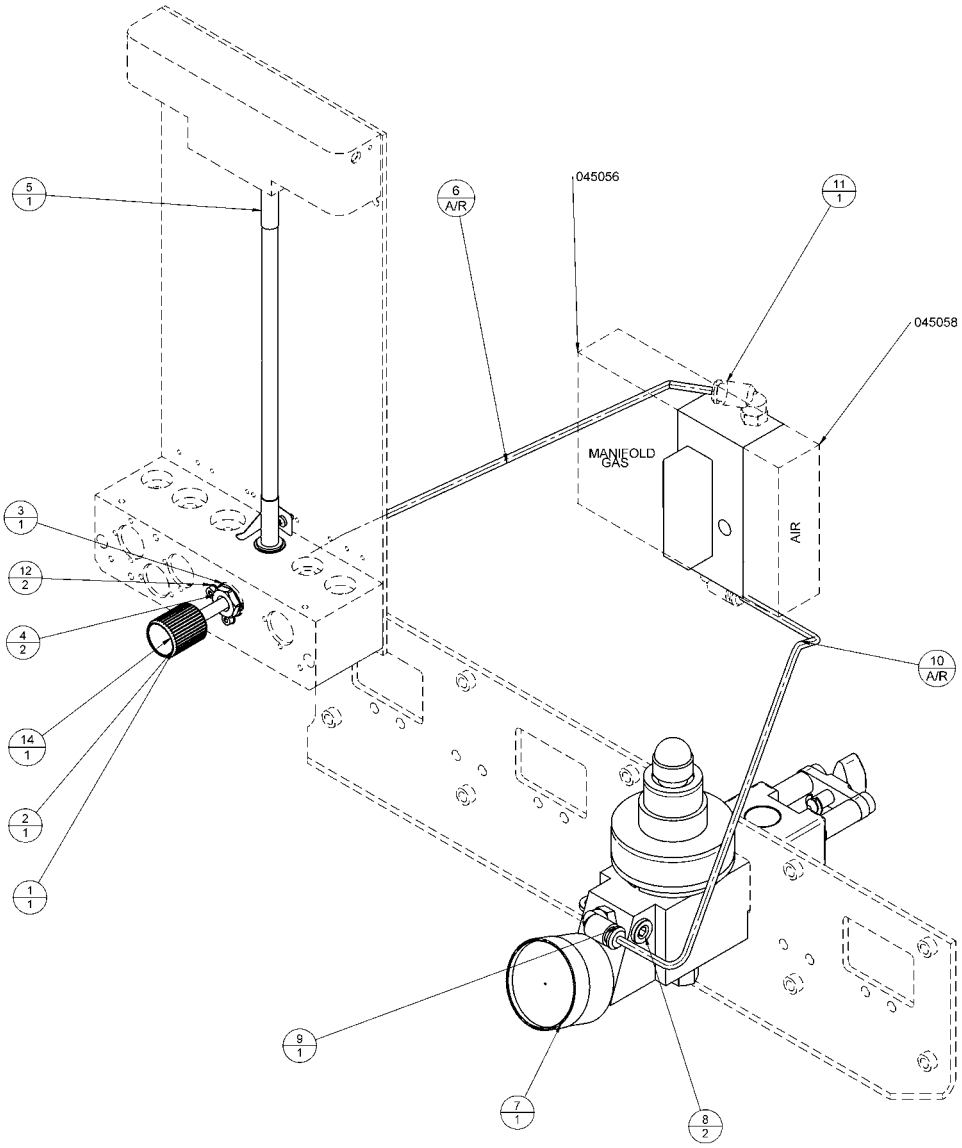
PARTS LIST

Air Cylinder / Pipeline Kit

Ref	Part No.	Description	Qty.
1	800230	Knob, Air	1
2	38318	Needle Valve	1
3	800224	Flow Tube, Air	1
4	800310	HP Gas Block, Air UK	1
	800306	HP Gas Block, Air USA	1
5	462542-A/R	5 mm Tube	As required
6	053207	Plug, G 1/8 with O-ring	2
7	800205	Low Pressure Gas Block, Air, UK	1
	800206	Low Pressure Gas Block, Air, USA	1
8	054519	Coupling	1
9	462542	5 mm Tube	1
10	462542	5 mm Tube	1
11	462542-A/R	5 mm Tube	As required
12	054917	Quick Release Coupling (auxiliary outlet, Air)	1
13	045068	Valve, Air	1
14	0581	Dowty Seal G1/8	1
15	054543	Elbow - 5 mm Tube	2
16	020014	Nut, M16 Lock	1
17	15064	Label, Air	2
18	0762	Filter	1
19	21240	Spring	1
20	700382	NIST Air Connector Body	1
	700389	DISS Air Connector Body	1
21	01067	M3 Plain Washer	2
22	019011	Screw, M3 x 6	2
23	054528	Stem Adaptor	1
24	01007	Screw, M6 x 16	4
25	054517	Tube Connector	1
26	01027	Grubscrew , M4 x 6	1
27	462542	5 mm Tube	1
28	045069	Actuator Switch	1
MA7 Supply			
	58267	Pipeline hose assembly kit, comprising:	1
	58268	Hose	1
	064274	Pressure reducing TU	1


28 1
5 A/R
13 1
3 1
19 1
17 2
20 1
2 1
1 1
26 1
18 1
17
16 1
22 2
21 2
4 1
11 A/R
4 1
10 A/R
23 1
8 1
7 1
9 A/R
15 2
12 1
14 1

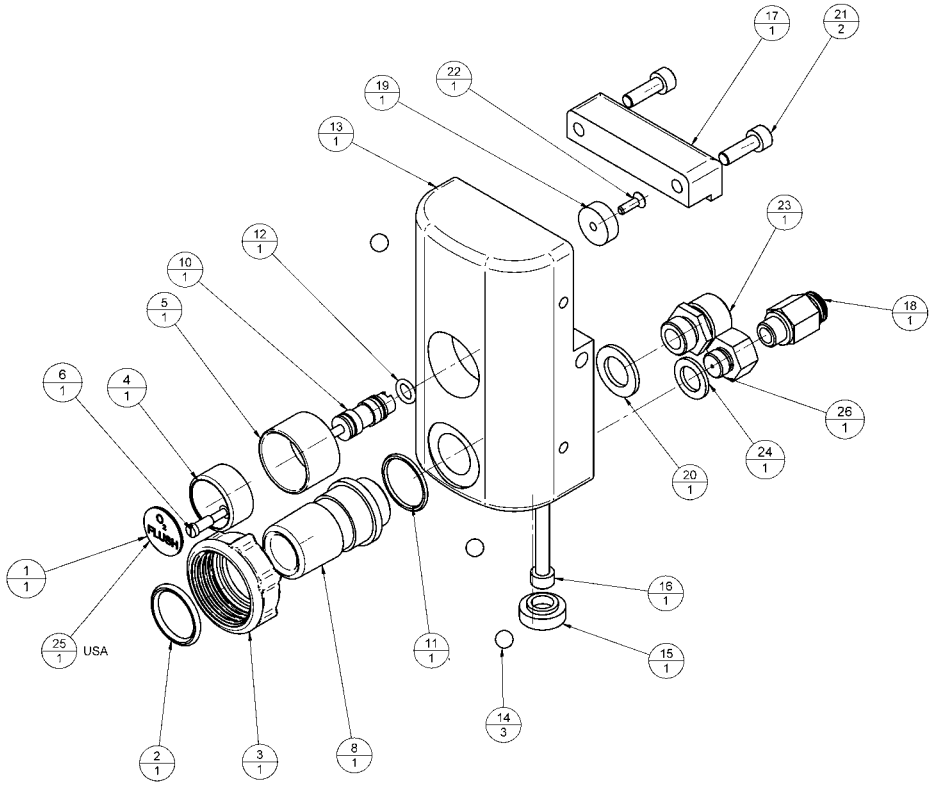
PARTS LIST



CO_2 Cylinder kit

Ref	Part No.	Description	Qty.
1	800230	Knob, CO_2	1
2	15279	Label, CO_2	1
3	38320	Needle Valve	1
4	019011	Screw, M3 x 6	2
5	800227	Flow Tube, CO_2 Low	1
6	462541-A/R	4 mm Tube	As required
7	800311	High Pressure Gas Block, CO_2	1
8	053207	Plug, G 1/8, with O-ring	2
9	054512	Elbow - 4 mm Tube	1
10	462542-A/R	5 mm Tube	As required
11	045057	Valve, CO_2	1
12	01067	M3 Plain Washer	2
13	01007	Screw, M6 x 16	2
14	01027	Grubscrew, M4 x 6	1
15	054516	Tube Connector	1

PARTS LIST



CGO Block

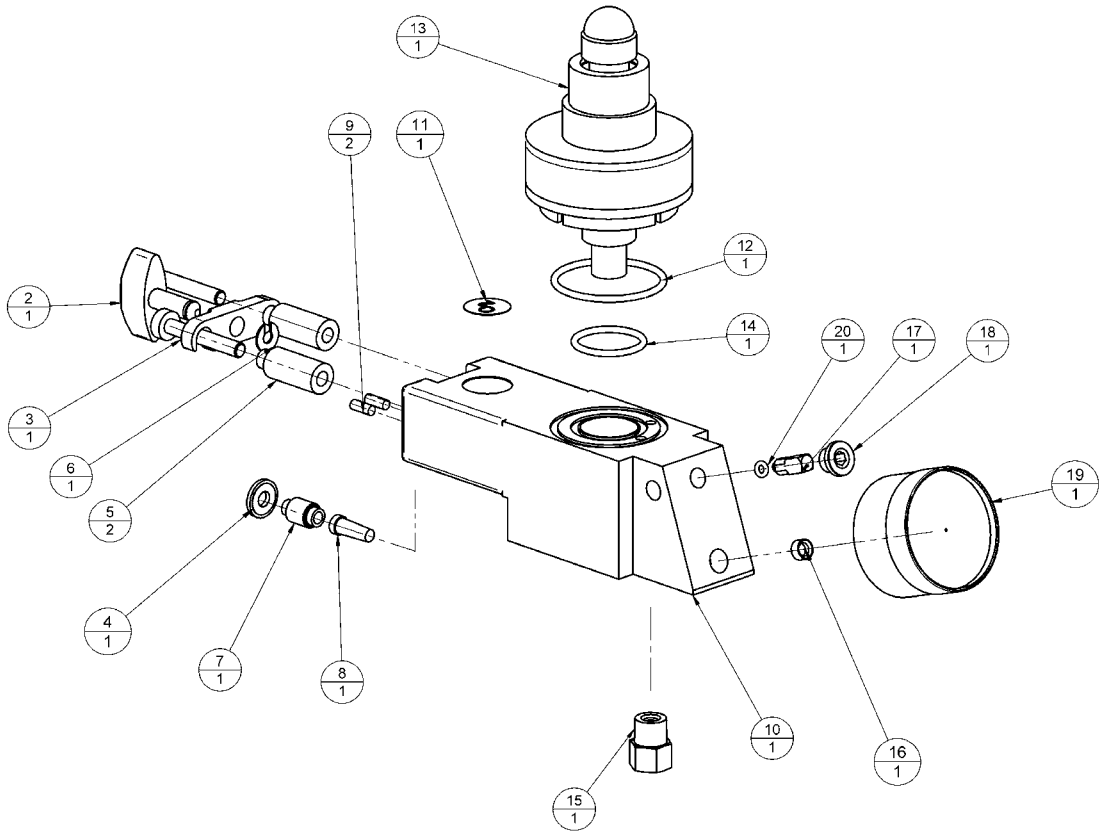
Ref	Part No.	Description	Qty.
1	15045	O_2 Flush Label	1
2	043	O-Ring BS116	1
3	034331	Safelock Nut	1
4	800471	Flush Button	1
5	800472	Button Shield	1
6	800473	Screw -Flush Button	1
8	89247	Outlet Male Connector	1
10	90183	Clippard Valve	1
11	0251	O-Ring Ø19.0 x 1.75 CSØ	1
12	0314	O-Ring	1
13	800257	CGO Block	1
14	0360	1/4" Ball	3
15	011107	Cap, M5 ‘Skiffy’	1
16	019164	Screw, M5 X 80	1
17	800258	CGO Rail Mount	1
18	054519	Coupling	1
19	800259	Wear Pad	1
20	0408	Dowty Seal G1/4	1
21	01130	Screw, M5 x 16	2
22	019073	Screw, M3 x 10	1
23	700650	Outlet Connector	1
24	0581	Dowty Seal G1/8	1
25	15135	Label O_2 Flush (Green)	1
26	800360	Adaptor (Orifice)	1

PARTS LIST

High Pressure Gas Block

Ref	Part No.	Description	Qty.
	800308	High Pressure Gas Block Assembly - O_2, UK	1
	800305	High Pressure Gas Block Assembly - O_2 (USA spec)	1
	800309	High Pressure Gas Block Assembly - N_2O	1
	800311	High Pressure Gas Block Assembly - CO_2	1
	800310	High Pressure Gas Block Assembly - Air, UK	1
	800306	High Pressure Gas Block Assembly - Air (USA spec)	1
1	019129	Screw, M6 x 40	2
2	011171	Knob	1
3	700447	Yoke Catch Plate	1
4	016	Bodok Seal	1
5	700446	Yoke Spacer	2
6	020406	Circlip	1
7	32444	Yoke Insert	1
8	0762	Filter	1
9	32058	Pin	2
10	700440	Gas Block, High Pressure	1
11	15252	Label, O_2, UK	1
	15051	Label, O_2, USA	1
	15277	Label, N_2O	1
	TBA	Label, CO_2	1
	15064	Label, Air, UK	1
	15278	Label, Air, USA	1
12	041122	O-ring	1
13	045444	HP Regulator	1
14	041121	O-ring	1
15	90283	Pressure Relief Valve	1
16	404194	Spacer	1
17	700438	Plunger	1
18	053207	Plug (G 1/8) complete with O-ring	1
19	049046	Gauge - O_2, UK, Cylinder	1
	049047	Gauge - O_2, USA, Cylinder	1
	049048	Gauge - N_2O, Cylinder	1
	049049	Gauge - CO_2, Cylinder	1
	049050	Gauge - Air, UK, Cylinder	1
	049051	Gauge - Air, USA, Cylinder	1
20	0691	O-ring 1/8" I/D x 0.07 CS	1

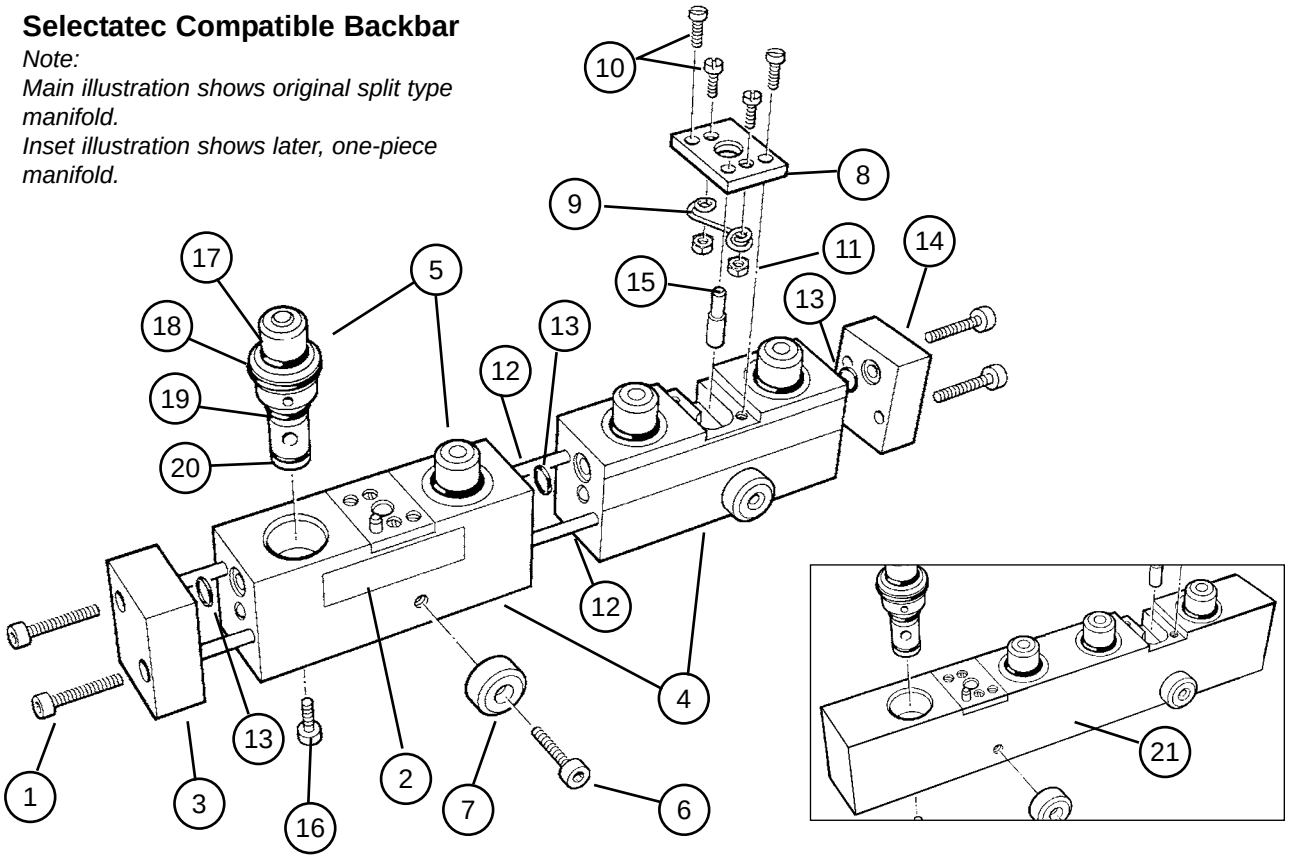
PARTS LIST



PARTS LIST

Selectatec Compatible Backbar

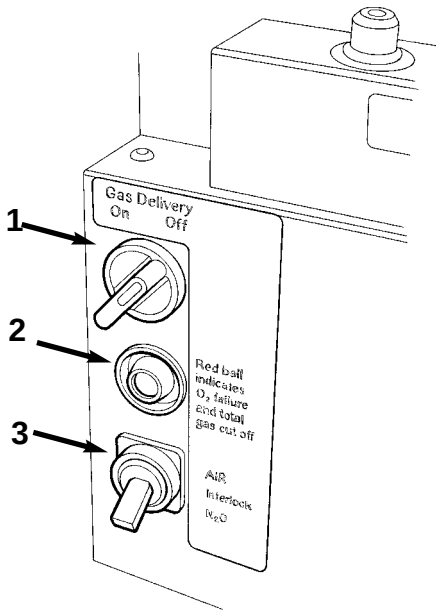
Note:
Main illustration shows original split type manifold.
Inset illustration shows later, one-piece manifold.



Ref	Part No.	Description	Qty.
1*	01253	Screw, M4 x 25 socket head	4
2	15464	Leak check label	2
3*	700636	Left hand end block	1
4*	700631	Manifold	2
5	045051	Valve capsule	4
6	01056	Screw, M5 x 12 socket head	2
7	71577	TEC 3 location button	2
8	700634	Clip retaining plate	2
9	022533	Dzus spring	2
10	01059	Screw, M2.5 x 6	8
11	01250	Nut, M2.5	4
12*	700647	Tie rod	2
13*	041202	O-ring	3
14*	700638	Right hand end block	1
15	71553	Interlock peg	2
16	019067	Screw, M4 x 12 socket head	4
17	041115	O-seal	4
18	041214	O-seal	4
19	041222	O-seal	4
20	041223	O-seal	4
21	800482	Manifold Block - two station - one piece	1
Not illustrated:			
	800481	Manifold Block - one station - one piece	1
	054540	Coupling (inlet and outlet)	2

** These components are not used on later, one-piece manifolds*

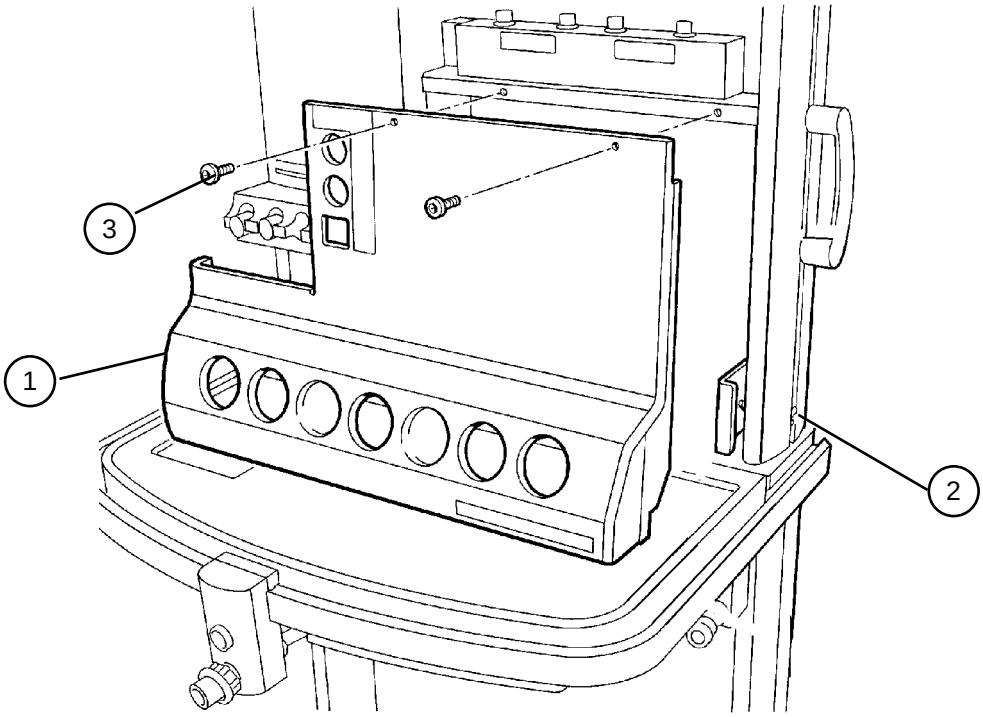
PARTS LIST



Ref	Part No.	Description	Qty.
1	045055	Gas delivery switch assembly	1
2	054945	Oxygen supply visual indicator assembly	1
3	045069	Gas interlock switch assembly	1

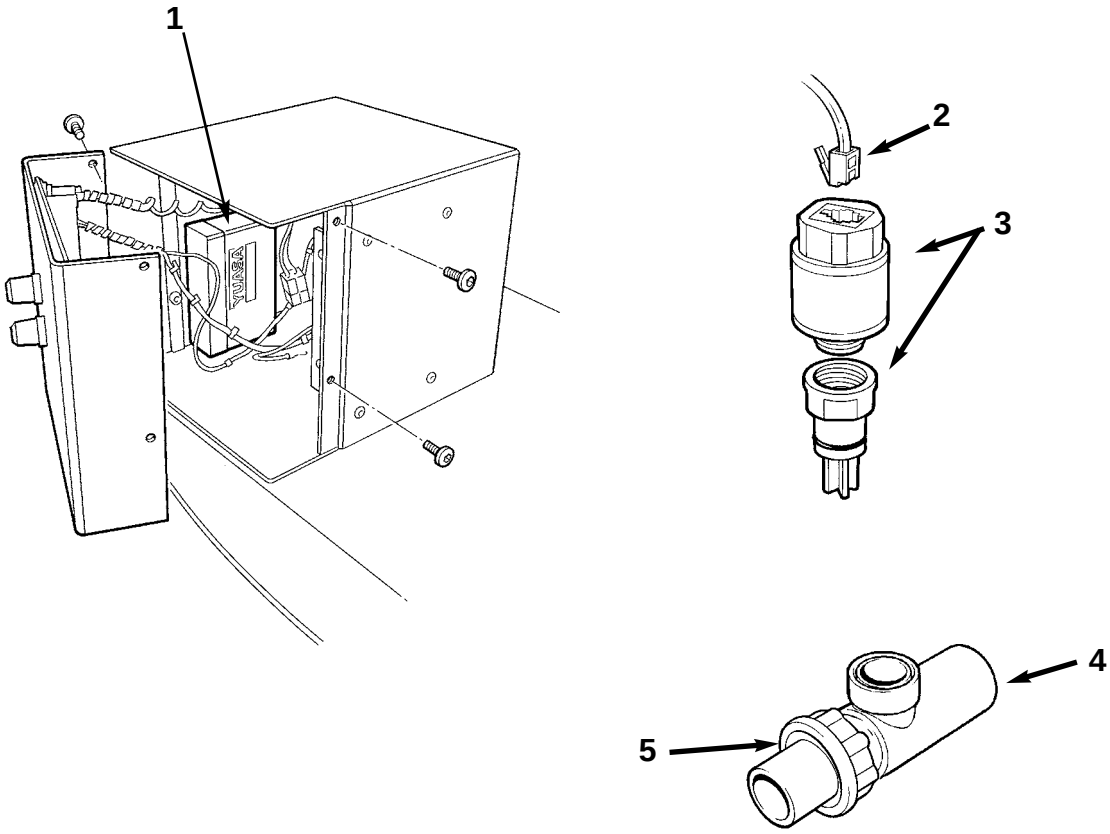
PARTS LIST

Gauge Cover



Ref	Part No.	Description	Qty.
1	800157	Cover - Prima SP 102	1
	800255	Cover - Prima SP 101	1
2	019033	Screw, M4 x 40 Csk Cross SS	2
3	019123	Screw, M4 x 10 Blk	2

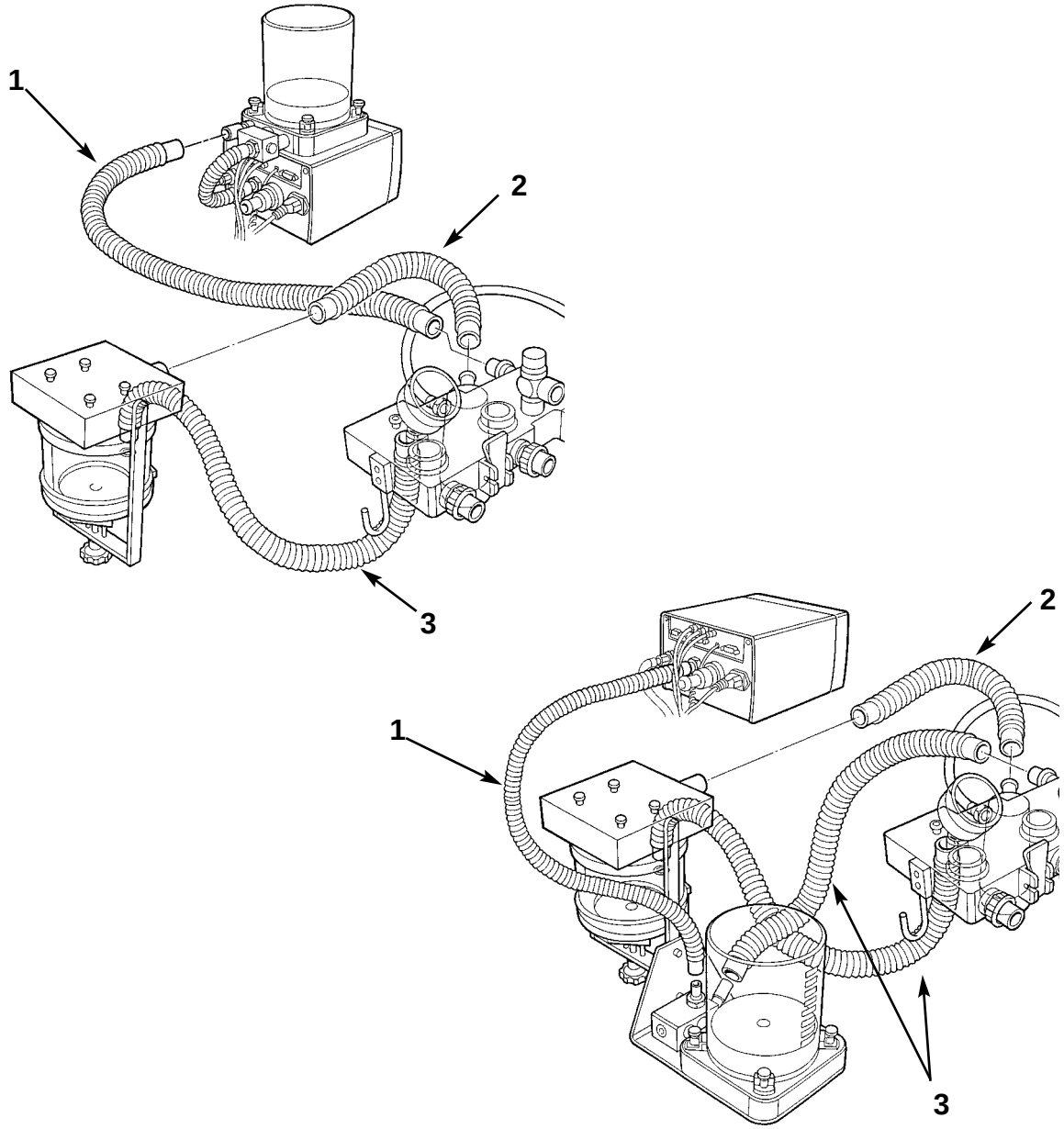
PARTS LIST



Oxygen Monitor

Ref	Part No.	Description	Qty.
1	700823	Battery	1
2	103472	Cable	1
3	102714	Sensor assembly - includes flow diverter and O-ring	1
4	800512	Tee-piece	1
5	043	O-ring (for Safelock connector)	1

PARTS LIST

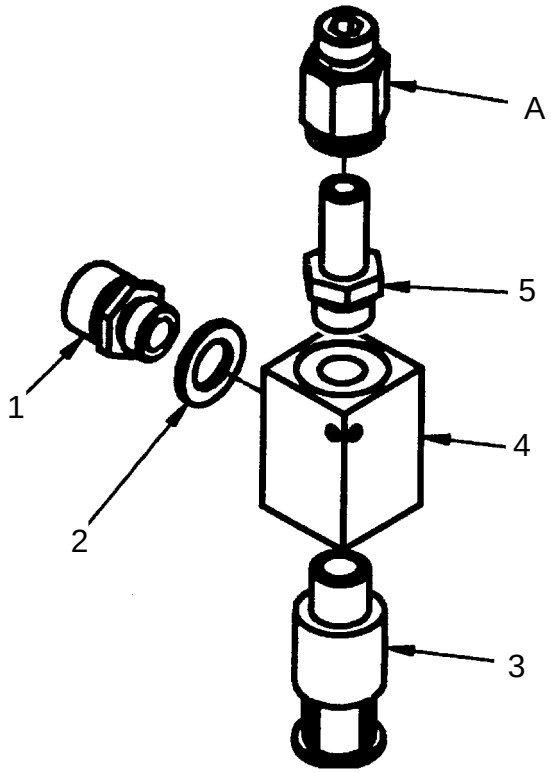


Hoses

(Prima SP with in-board A100 Absorber and stand-alone AV900 Ventilator)

Ref	Part No.	Description	Qty.
1	58459	Hose - 1.5 m	1
2	011292	Hose - 300 mm	1
3	011291	Hose - 600 mm	As required

PARTS LIST

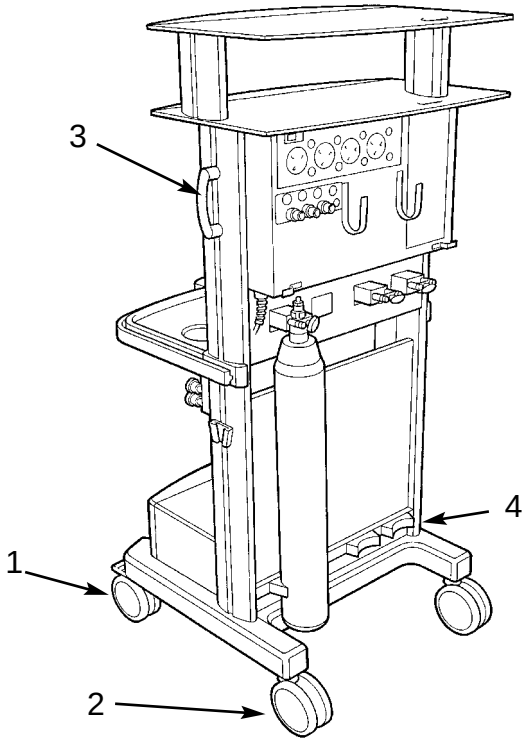


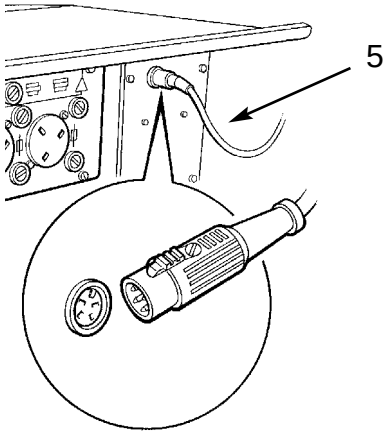
Pressure Relief Valve (PRV)

Ref	Part No.	Description	Qty.
1	700650	Outlet connector	1
2	0408	Dowty seal	1
3	045435	Pressure relief valve (PRV)	1
4	800238	Manifold block - PRV	1
5	054525	Stem adaptor	1

Note
Coupling 'A' connects the PRV to the vaporizer manifold block, see page 132 for part number details

PARTS LIST





Miscellaneous Components

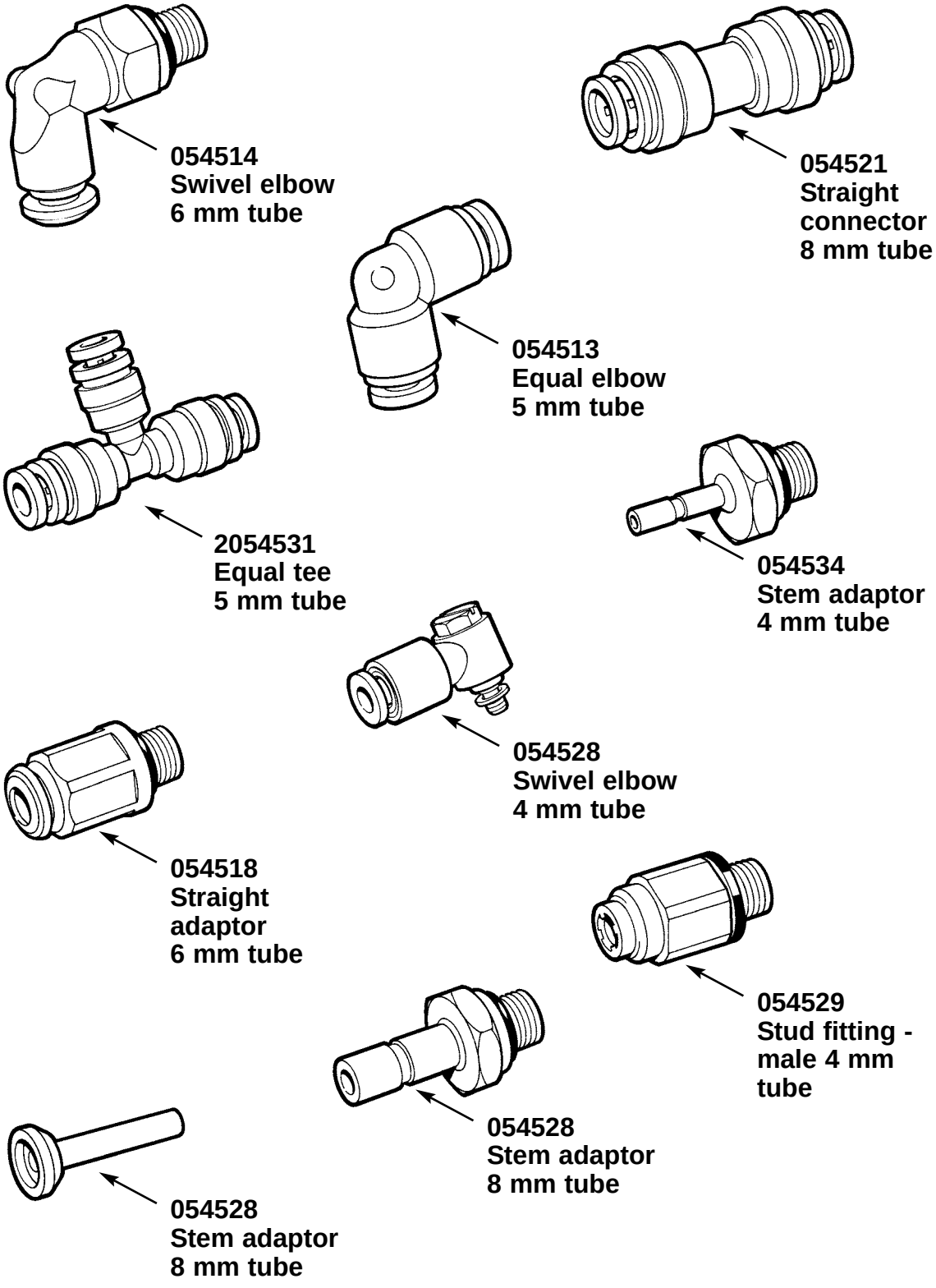
Ref	Part No.	Description	Qty.
1	000083	Castor - locked (front)	2
2	000084	Castor (rear)	2
	01252	Star washer, M6	As required
	800644	Tube hook	As required
	025206	Spring washer, dia 16 mm	4
3	011163	Handle	2
	01028	Screw, M6 x 30	4
	01015	Washer, M6	4
	800192	T-nut	4
4	800483	Bump stop	As required
	800548	Screw, No 12 x 20	As required

Interface and Spirometry Cables

5	300414	1	Interface Cable - AV900 V4 to Prima SP (560 mm)
-	300415	1	Interface Cable Assembly - A100SP Absorber to Prima SP - consists of socket assembly and two cables

PARTS LIST

Tubing Connectors



11. Appendix

APPENDIX 1

Machines with Oxygen Monitor
Care of Back-up Battery

A. Batteries installed in machines

The batteries must be charged before the machine is released for use with a 24 hour charge.
Subsequently the recharge periods for batteries on machines in store are similar to those in B, below.

Batteries in machines in normal use will be kept charged by the internal power supply and will only require special charging care following the discharge test carried out during function testing.

B. Battery care/storage requirements.

During storage the batteries will require a periodic recharge, the frequency of which is determined by the storage temperature, which must not exceed 122^{o}F (50^{o}C).

Storage temperature	*Recharge period*
38 to 50^{o}C (100 to 122^{o}F)	1 month
21 to 38^{o}C (70 to 100^{o}F)	3 months
7 to 21^{o}C (45 to 70^{o}F)	6 months
0 to 7^{o}C (32 to 45^{o}F)	9 months
-5 to 0^{o}C (23 to 32^{o}F)	12 months

Duration - recharge until the charge current is less than 25 mA (typically overnight).

It is recommended that at each charge an updated label is affixed to each battery to indicate date of the last charge.

C. Disposal of used batteries

Used batteries must be disposed of according to hospital, local, state and federal regulations.

Appendix

APPENDIX 2

Product Classification and Labelling Terminology

The terms *Class 1* and *Type B* are defined in IEC 601-1 (the standard for electrical medical equipment).

This symbol denotes: Type B equipment

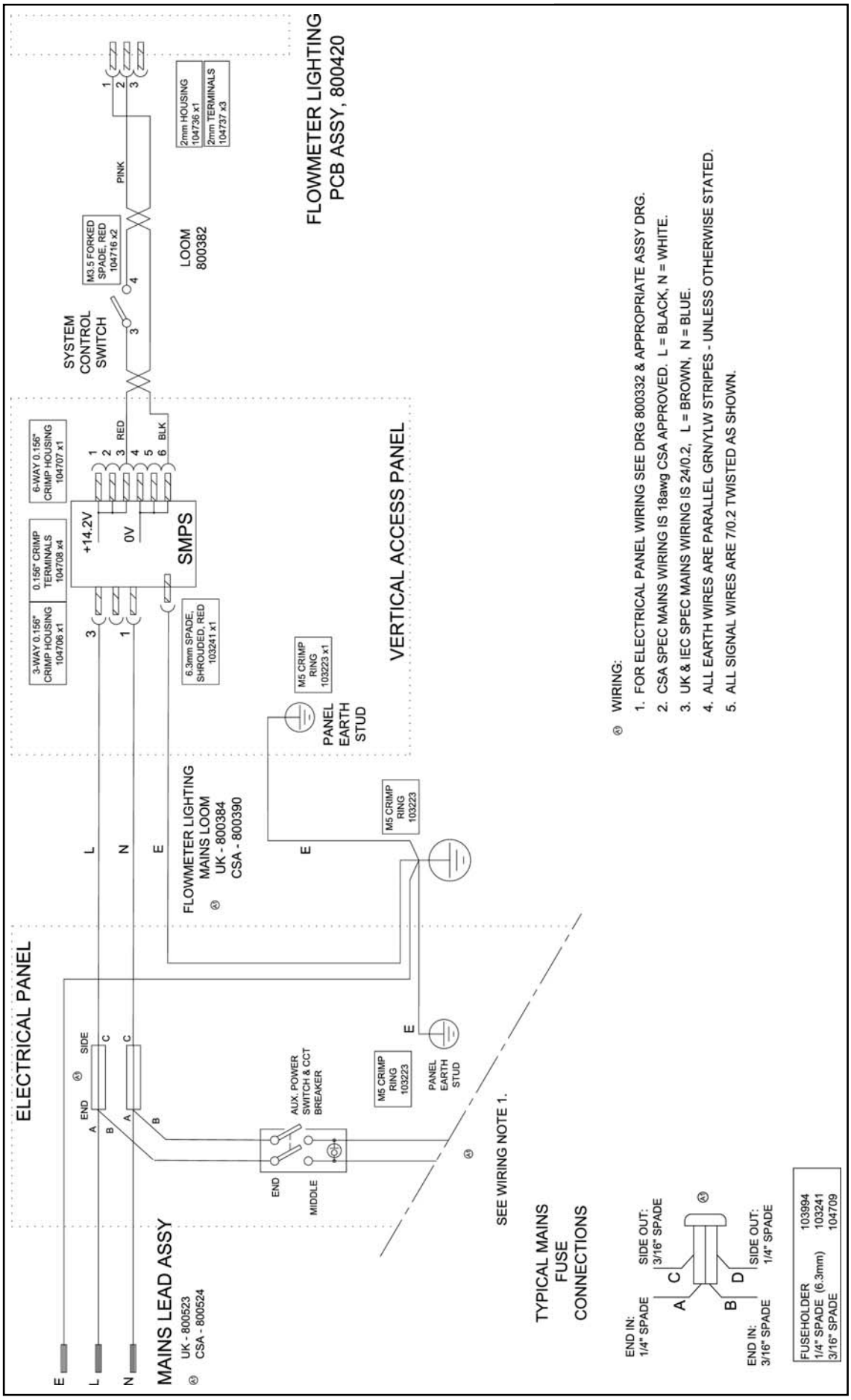
Type B equipment calls for a particular degree of protection against electric shock.

Class 1 equipment has additional protection such that metal parts of the unit that are accessible to the user (e.g. the metal casing of the oxygen monitor unit) cannot become live in the event of failure of the basic insulation of the electrical components within the unit.

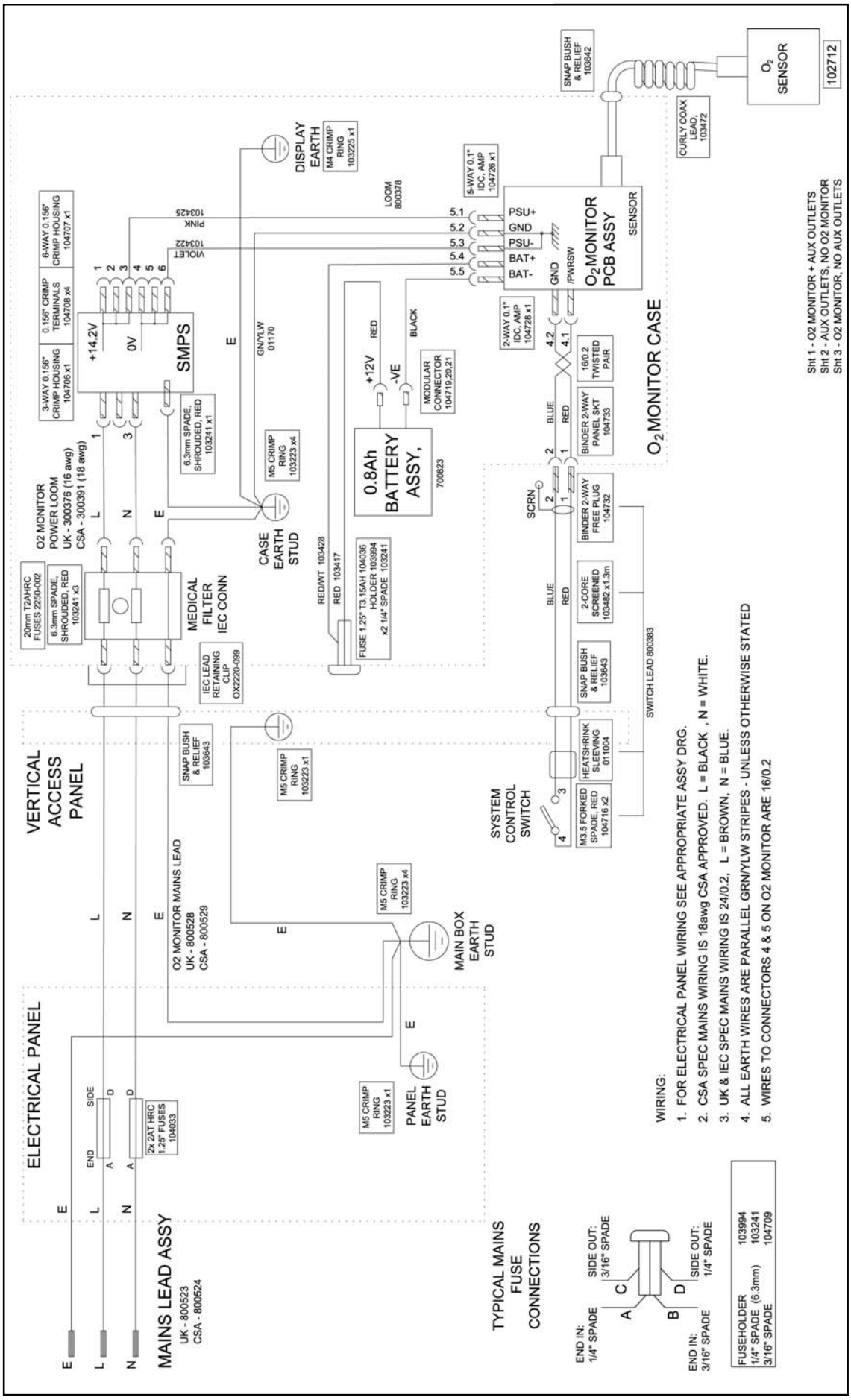
This symbol denotes: Refer to the User Manual

APPENDIX 3

Lighting System - Wiring Diagram


ELECTRICAL PANEL
MAINS LEAD ASSY
UK - 800523
CSA - 800524
E
L
N
END
SIDE
AUX. POWER SWITCH & CCT BREAKER
END
MIDDLE
M5 CRIMP RING 103223
PANEL EARTH STUD
SEE WIRING NOTE 1.
TYPICAL MAINS FUSE CONNECTIONS
END IN: 1/4" SPADE
SIDE OUT: 3/16" SPADE
SIDE OUT: 1/4" SPADE
END IN: 3/16" SPADE
FUSEHOLDER 103994
1/4" SPADE (6.3mm) 103241
3/16" SPADE 104709
FLOWMETER LIGHTING MAINS LOOM
UK - 800384
CSA - 800390
3-WAY 0.156" CRIMP HOUSING 104706 x1
0.156" CRIMP TERMINALS 104708 x4
6.3mm SPADE, SHROUDED, RED 103241 x1
+14.2V
0V
SMPS
6-WAY 0.156" CRIMP HOUSING 104707 x1
RED
BLK
SYSTEM CONTROL SWITCH
M3.5 FORKED SPADE, RED 104716 x2
PINK
LOOM 800382
2mm HOUSING 104736 x1
2mm TERMINALS 104737 x3
FLOWMETER LIGHTING PCB ASSY, 800420
VERTICAL ACCESS PANEL
WIRING:
1. FOR ELECTRICAL PANEL WIRING SEE DRG 800332 & APPROPRIATE ASSY DRG.
2. CSA SPEC MAINS WIRING IS 18awg CSA APPROVED. L = BLACK, N = WHITE.
3. UK & IEC SPEC MAINS WIRING IS 24/0.2, L = BROWN, N = BLUE.
4. ALL EARTH WIRES ARE PARALLEL GRN/YLW STRIPES - UNLESS OTHERWISE STATED.
5. ALL SIGNAL WIRES ARE 7/0.2 TWISTED AS SHOWN.

Wiring Diagram


ELECTRICAL PANEL
VERTICAL ACCESS PANEL
MAINS LEAD ASSY
UK - 800523
CSA - 800524
O2 MONITOR MAINS LEAD
UK - 800528
CSA - 800529
O2 MONITOR POWER LOOM
UK - 300376 (16 awg)
CSA - 3003391 (18 awg)
SMPS
+14.2V
0V
MEDICAL FILTER IEC CONN
IEC LEAD RETAINING CLIP OX2220-099
CASE EARTH STUD
DISPLAY EARTH
MAIN BOX EARTH STUD
PANEL EARTH STUD
0.8Ah BATTERY ASSY, 700823
+12V
-VE
MODULAR CONNECTOR 104719,20,21
SYSTEM CONTROL SWITCH
SWITCH LEAD 800383
LOOM 800378
O2 MONITOR PCB ASSY
PSU+
GND
PSU-
BAT+
BAT-
SENSOR
O2 SENSOR
CURLY COAX LEAD, 103472
SNAP BUSH & RELIEF 103642
BINDER 2-WAY PANEL SKT 104733
BINDER 2-WAY FREE PLUG 104732
16/0.2 TWISTED PAIR
2-CORE SCREENED 103486 x1.3m
HEATSHRINK SLEEVING 011004
SNAP BUSH & RELIEF 103643
M5 CRIMP RING 103223 x1
M5 CRIMP RING 103223 x4
M4 CRIMP RING 103225 x1
6.3mm SPADE, SHROUDED, RED 103241 x1
6.3mm SPADE, SHROUDED, RED 103241 x3
20mm T2AHRC FUSES 2250-002
2x 2AT HRC 1.25" FUSES 104033
FUSE 1.25" T3.15AH 104036 HOLDER 103994 x2 1/4" SPADE 103241
3-WAY 0.156" CRIMP HOUSING 104706 x1
0.156" CRIMP TERMINALS 104708 x4
6-WAY 0.156" CRIMP HOUSING 104707 x1
5-WAY 0.1" IDC, AMP 104726 x1
2-WAY 0.1" IDC, AMP 104728 x1
M3.5 FORKED SPADE, RED 104716 x2
TYPICAL MAINS FUSE CONNECTIONS
END IN: 1/4" SPADE
SIDE OUT: 3/16" SPADE
END IN: 3/16" SPADE
SIDE OUT: 1/4" SPADE
FUSEHOLDER 1/4" SPADE 103994
(6.3mm) 103241
3/16" SPADE 104709
WIRING:
1. FOR ELECTRICAL PANEL WIRING SEE APPROPRIATE ASSY DRG.
2. CSA SPEC MAINS WIRING IS 18awg CSA APPROVED. L = BLACK , N = WHITE.
3. UK & IEC SPEC MAINS WIRING IS 24/0.2, L = BROWN, N = BLUE.
4. ALL EARTH WIRES ARE PARALLEL GRN/YLW STRIPES - UNLESS OTHERWISE STATED
5. WIRES TO CONNECTORS 4 & 5 ON O2 MONITOR ARE 16/0.2
Sht 1 - O2 MONITOR + AUX OUTLETS
Sht 2 - AUX OUTLETS, NO O2 MONITOR
Sht 3 - O2 MONITOR, NO AUX OUTLETS
102712

Appendix

APPENDIX 4
Fixings Tightening Torques

Note:
Only suitably skilled and trained persons should carry out service and maintenance procedures on this anaesthesia equipment.

Specific torque values are given where required.

Where specific torque values are not provided, screws and fittings should be tightened using a reasonable degree of tightness and skill. Where torque guidance is required, the following values may be used.

1 General tightening torques.

Diameter	*Type*	*Torque Nm*
M3	Cap Head screws	1.7 - 2.0
	Csk & Button head screws	0.9 - 1.2
M4	Cap Head screws	4.2 - 4.5
	Csk & Button head screws	3.1 - 3.4
M5	Cap Head screws	7.0 - 7.5
	Csk & Button head screws	6.0 - 6.5
M6	Cap Head screws	7.5 - 8.0
	Csk & Button head screws	6.5 - 6.8
M8	Cap Head screws	13 - 13.6
	Csk & Button head screws	11.5 -12

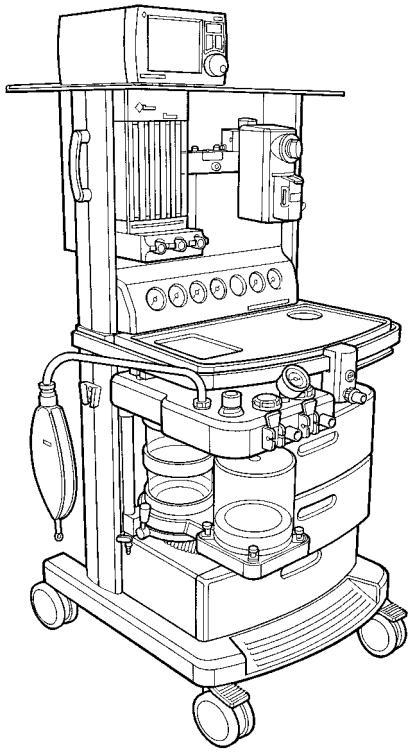
2 Specific torque values

Diameter	*Where used*	*Torque Nm*
M4	Cylinder bump stop	Tighten to take up slack, and then 2.5 turns
M6	Cylinder Yokes	7 - 8
M6	Yoke mounting plate into rivet bushes	6 - 7
M8	Top tray fixings	10 -12
M8	Work surface to vertical extrusion	12 -14
M16	Castor fixings	20 - 22
	CGO Taper fitting	38 - 42
M8	Base to vertical extrusions	14 - 16
M6	Vertical extrusion T nuts	5 - 6
M6	Main control box to vertical extrusions	3 - 4
M3	AHD gear grub screws	0.5 - 1.0
M4	Front panel	1.0 - 2.0
M2.5	Flowmeter cover screws	0.27 - 0.32

Appendix

APPENDIX 5

A100SP Absorber



This information must be used in conjunction with the A100 User Instruction Manual (Cat No 52689).

A100SP Absorber Features

1. Interface with AV900 V4 Ventilator
   The A100SP is fitted with fitted with a sensor that detects the position of the absorber bag/vent lever. **Note that the Bag/Vent lever is fitted on the left hand side of the manifold block (viewed from the front of the machine).**
   The sensor signal cabling is routed internally to a connector at the rear of the absorber valve block

   Operation of the Bag/Vent lever will trigger automatic Mode switching on the AV900 ventilator, as follows:
   a) If the Absorber Bag/Vent Lever is moved from Vent to Bag, the ventilator will change from Volume Mode, or Pressure Mode, into Spontaneous Mode.
   b) Switching the absorber Bag/Vent lever from Bag to Vent will reset the ventilator from Spontaneous Mode to Standby Mode.
   If the ventilator is in any mode other than those detailed above, operation of the absorber Bag/Vent lever will not affect the ventilator.
   NOTE
   This function can be enabled/disabled through the AV900 V4 on-screen menus (Service Sub-menu, see section 3.5.4 in the ventilator User Manual).

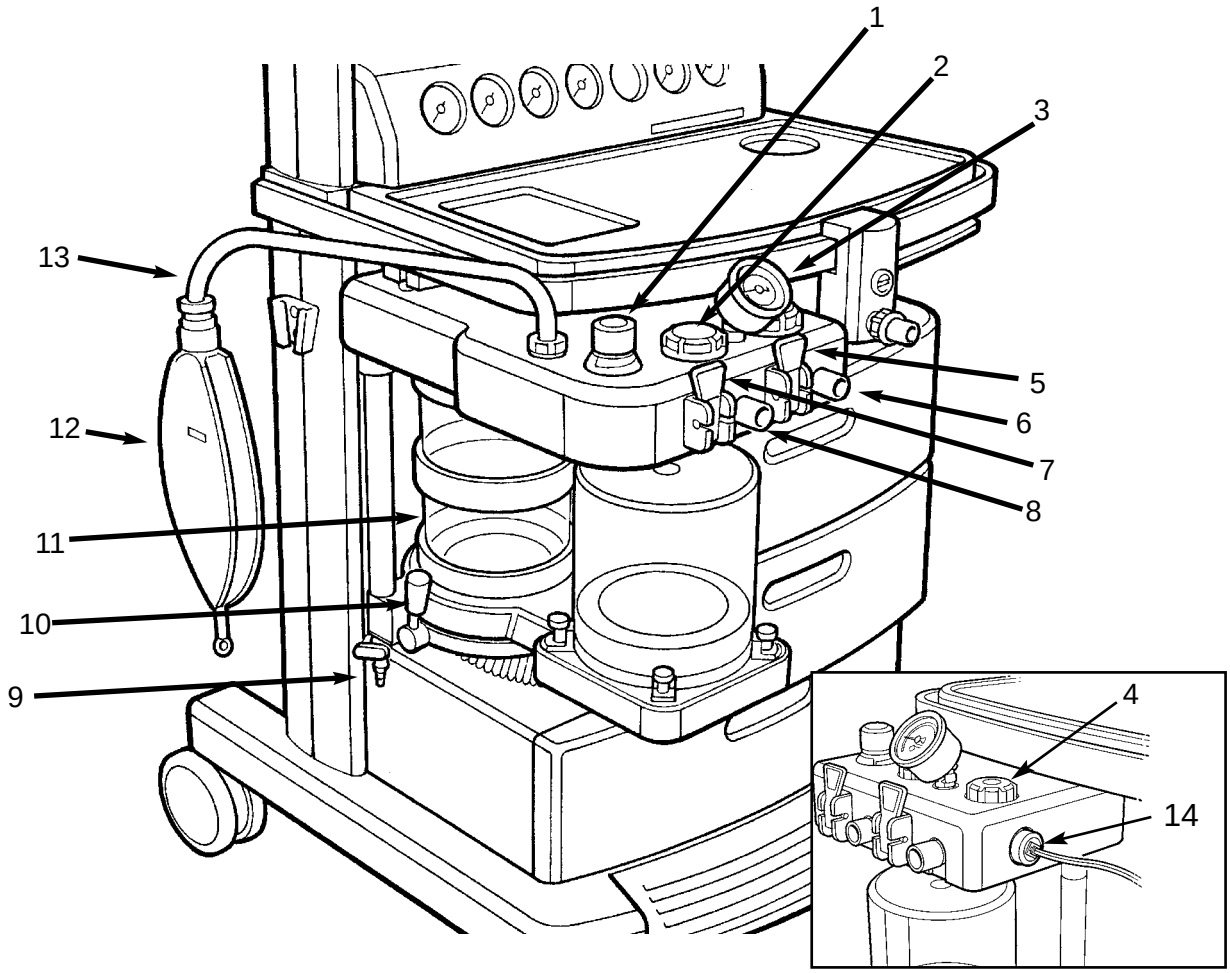
2. The spirometer flow sensor heads are built into the inspiratory and expiratory airways within the absorber.
   The sensor signal cabling is routed internally to a connector at the rear of the absorber valve block

3. The sensor for the oxygen monitor is built into the inspiratory airway within the absorber.

4. The breathing bag is mounted on a rotating arm.

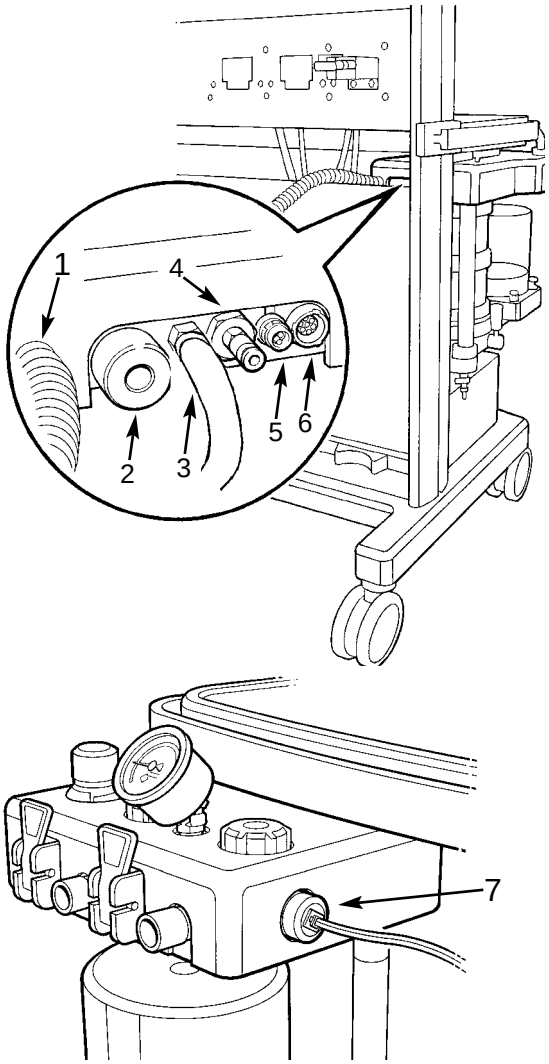
5. The canister-release mechanism is operated by a lever at the base of the canister assembly.

6. Gas flow through the canisters is from top to bottom.



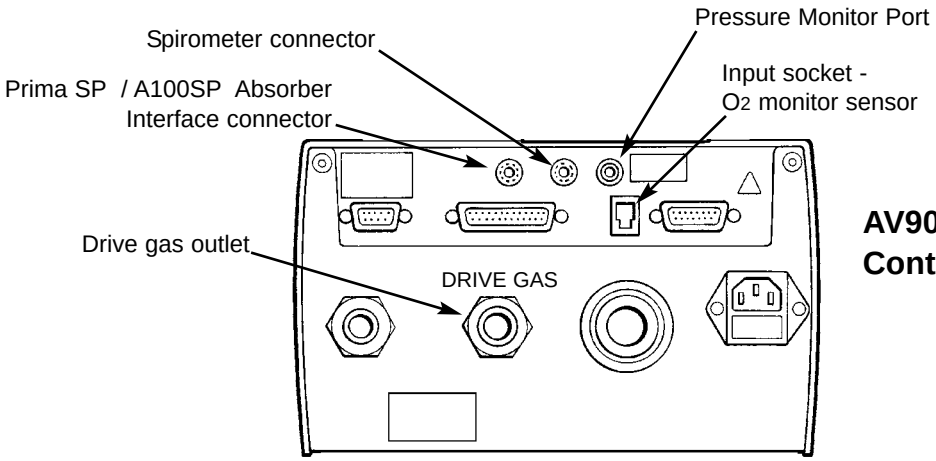
A100SP Circle System Absorber mounted on Prima SP Anaesthetic Machine
The absorber is fitted with optional on/off (bypass) switch, and manometer

1. Adjustable pressure limiting valve (APL valve)
2. Expiratory non-return valve (NRV)
3. Manometer (optional)
4. Inspiratory non-return valve (NRV)
5. Absorber on/off (bypass) switch (optional)
6. Inspiratory hose connector
7. Bag/ventilator switch
8. Expiratory hose connector
9. Condensate drain
10. Canister lever
11. Canister assembly
12. Reservoir bag
13. Bag swivel arm
14. Oxygen sensor



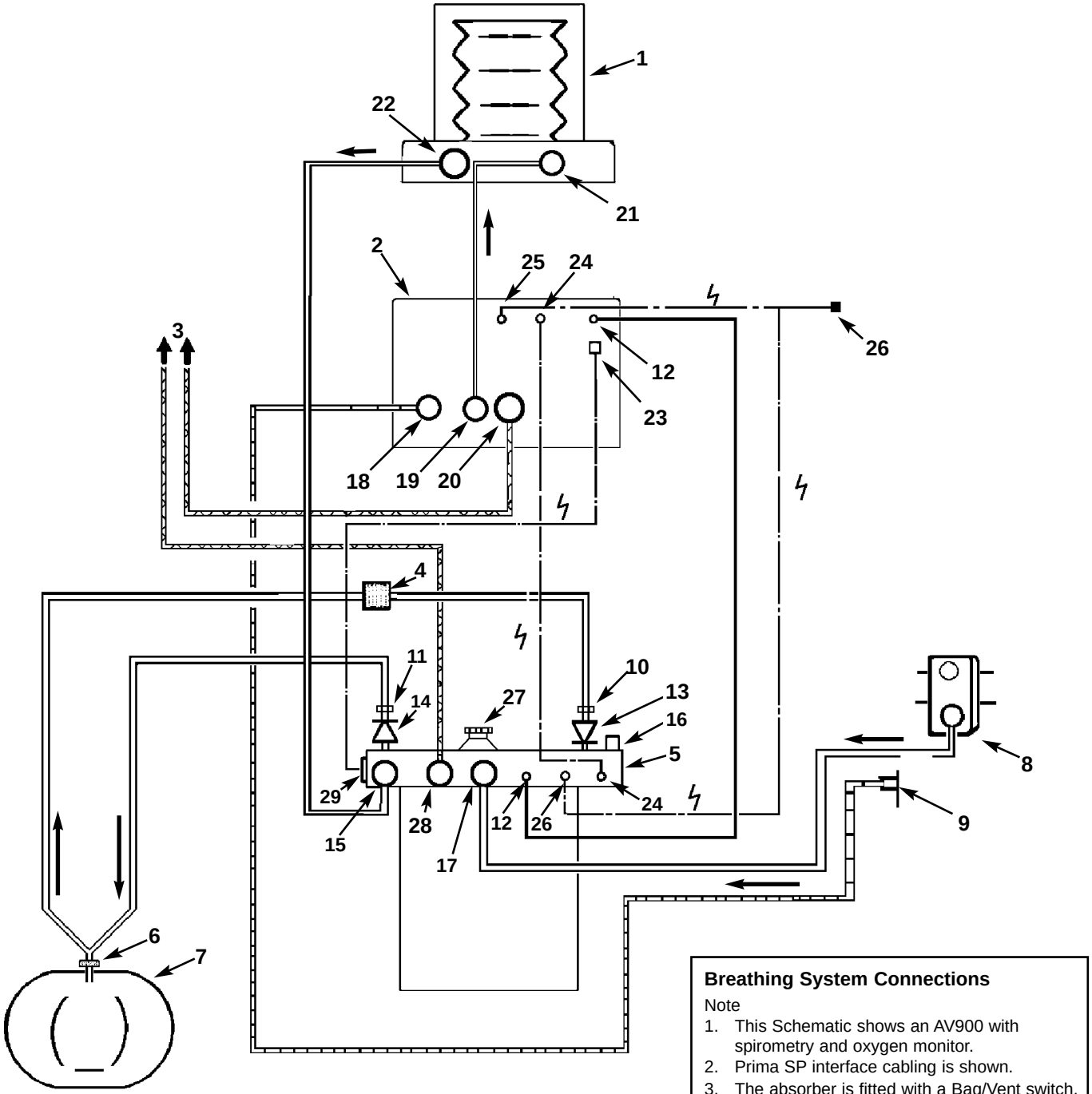
A100SP / AV900 V4 connections

1. Inlet - from DRIVE GAS outlet on AV900 control unit.
2. Exhaust outlet from APL Valve - connect to Anaesthetic Gas Scavenge System
3. Inlet - fresh gas hose from anaesthetic machine Common Gas Outlet
4. Outlet - sample line to Pressure Monitor Port on ventilator (AV900 / AV800 etc)
5. Interface cable - Bag/Vent switch (connects internally to Prima SP On/Off Switch interface, then to connector on AV900 rear panel).
6. Spirometer signal cable - connected to socket on AV900 V4 rear panel.
7. Oxygen monitor sensor - connected to socket on AV900 rear panel



AV900 V4 Ventilator Control Unit Rear Panel

Schematic - Breathing System Connections



Breathing System Connections

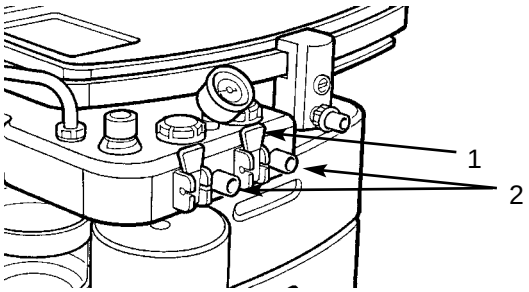
Note

1. This Schematic shows an AV900 with spirometry and oxygen monitor.
2. Prima SP interface cabling is shown.
3. The absorber is fitted with a Bag/Vent switch.

1. Bellows
2. Ventilator Control Unit
3. Outlets to Anaesthetic Gas Scavenging System (AGSS)
4. Bacterial Filter
5. Absorber valve block
6. Heat and moisture exchanger
7. Patient
8. CGO Block on anaesthetic machine (Fresh Gas Supply)
9. Auxiliary Outlet on anaesthetic machine (Drive Gas Supply)
10. Flow sensor - expiratory
11. Flow sensor - inspiratory
12 Connectors - sensor - pressure monitor
13. Expiratory Valve - Absorber
14. Inspiratory Valve - Absorber
15. Inlet - from Ventilator
16. Connector - Reservoir Bag
17. Inlet - Absorber - Fresh Gas Supply
18. Drive Gas Inlet - Ventilator
19. Drive gas Outlet - ventilator control unit to bellows
20. Outlet - Exhaust Valve
21. Inlet - Bellows Drive Gas
22. Outlet - to breathing system
23. Input socket - Oxygen monitor sensor
24. Spirometer cable connectors
25. Input socket - Prima SP interface (SP on/off switch, and A100SP Absorber Bag/Vent lever position)
26. Interface connections on Prima SP and A100SP
27. APL Valve
28 Outlet from APL Valve to AGSS
29 Oxygen sensor

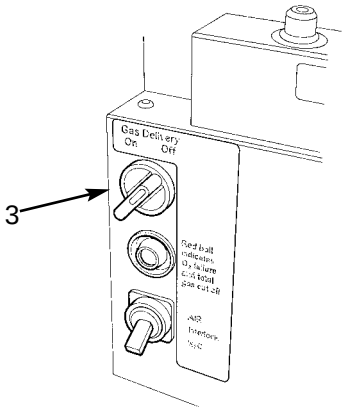
AV900 Ventilator - Oxygen Sensor Calibration

Calibrate the AV900 oxygen monitor system with the sensor in position in the absorber.



1. Pull the Absorber On / Off lever (1) down to its OFF position.
   The flow will bypass the absorbent.

2. Remove the breathing circuit hoses from the inspiratory and expiratory connectors (2) on the absorber.
   This will give a free flow of oxygen through the sensor.



3. Switch on the ventilator and the anaesthetic machine gas delivery switch (3).
   The oxygen monitor automatically switches ON when the ventilator is switched on.
   Ensure that all vaporizers are OFF.

4. Apply 100% oxygen only, at 5 L/min, from the flowmeter.

5. Allow the oxygen to flow until the oxygen monitor readout stabilises.

6. Calibrate the sensor, using the AV900 ventilator menu procedure.

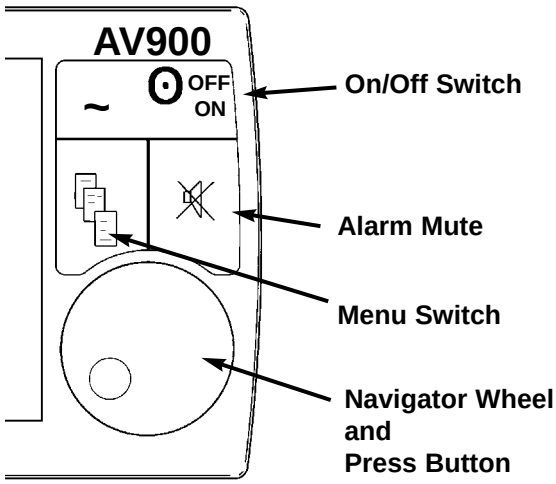
7. Press the menu switch and select the O_2 monitor sub-menu.

8. Scroll to CALIBRATION.
   If the menu shows 21% (calibration using air), press the navigator wheel to switch to 100% (calibration using oxygen).

9. A message will flash on the screen:
   O2 AT 100% ?
   Press the button to confirm
   NOTE
   The message:
   OXYGEN SENSOR LOW OUTPUT
   will appear on screen if the user attempts to calibrate at 21% in 100% oxygen.

10. Repeat operations 8 and 9 twice more.
11. Scroll to ESCAPE FROM MENUS and press the wheel to exit.

12. Turn off the flow of oxygen.



O_2 Monitor sub-menu - calibration

	O_2 MONITOR : ON
>	CALIBRATION: 100%
	HIGH ALARM SET
	LOW ALARM SET
	ESCAPE FROM MENUS

AV900 Ventilator - Spirometry Calibration

The Spirometry heads must be calibrated with zero flow going through them.

1. Turn the Prima SP off at the Gas Delivery switch (1).
   This will stop all gas flows (including the AHD basal flow).
   This will also turn the AV900 off.

2. Turn the AV900 on at the ventilator (Do not use the SP Gas Delivery switch).

3. Remove the breathing circuit hoses from the inspiratory and expiratory connectors (2) on the absorber.

4. Disconnect the fresh gas hose from the CGO block on the anaesthetic machine.

5. Disconnect the hose from the APL valve outlet (3) at the rear of the manifold block

6. a) Ensure that the ventilator bellows is empty, or,
   b) Remove the bag, and set the Bag/Vent lever (4) to Bag position.

7. Calibrate the spirometer via the ventilator menu procedure.
   NOTE
   Do NOT remove the spirometer heads.

8. Press the menu switch on the front panel.

9. Scroll down the main menu and select SPIROMETRY.

10. Scroll down the sub-menu and select CALIBRATION.

11. Turn the wheel to switch display to CALIBRATION: cal

12. A message will appear:
    Remove the spirometer head
    Do NOT remove the spirometer heads

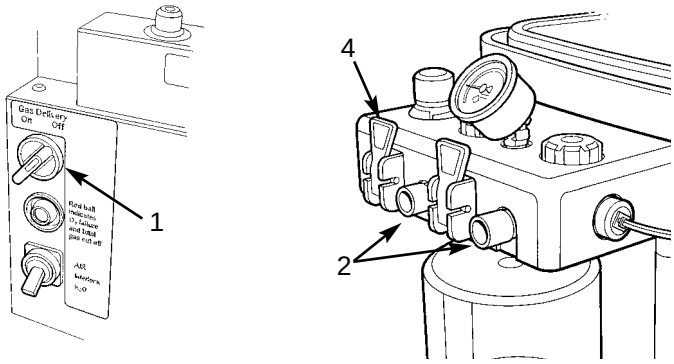
13. Press the wheel to initiate calibration.

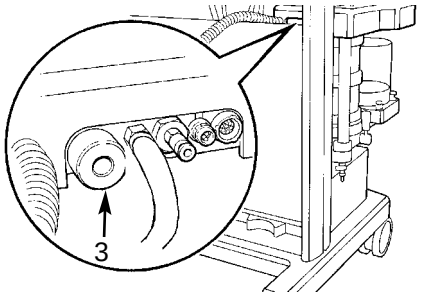
14. Repeat operations 8 to 12, twice more.

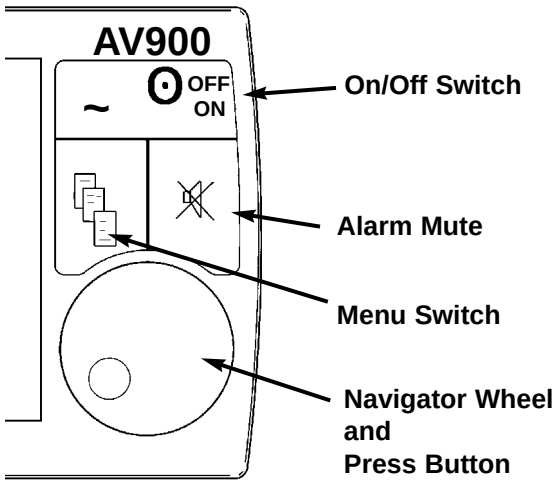
15. Calibration is completed.

16. Scroll to ESCAPE FROM MENUS.

17. Press the wheel to confirm.







Main menu

```
   O2 MONITOR
>  SPIROMETRY
   FRESH GAS COMPENSATION : ON
   GAS MIXTURE
   VOLUME TYPE
   WAVEFORM
   SERVICE
   ESCAPE FROM MENUS
```

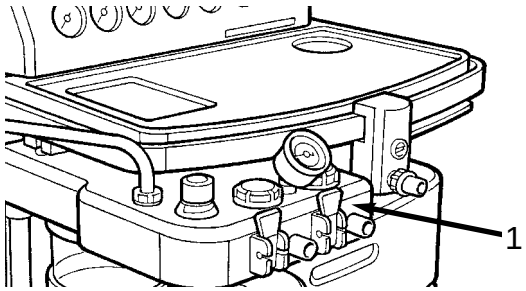
Spirometry sub-menu

```
   SPIROMETRY : ON
>  CALIBRATION : cal
   ESCAPE FROM MENUS
```

Filling and Changing CO_2 Absorbent

WARNING

If the absorbent is to be changed during clinical use, the bypass switch (1) must be in the 'Absorber OFF' position, and adequate fresh gas flow must be maintained to prevent excessive build up of CO_2.



Removing the canisters

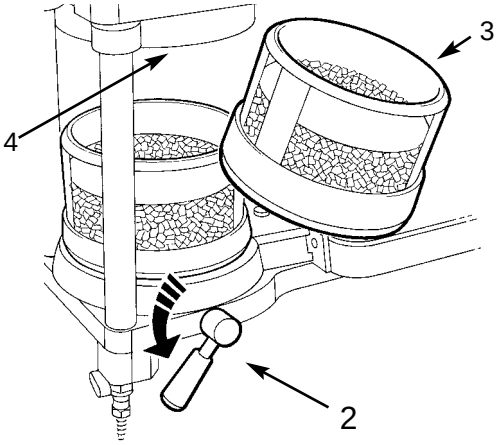
1. Turn the lever (2) at the base of the absorber anti-clockwise.

   This leaves space between the top and bottom of the canister frame for the top canister (3) to be removed sideways after disengaging the rubber seals by vertical movement.

2. The absorbent in the top canister is always exhausted first, so the canisters should be rotated as follows:

(a) lift the top canister from the frame and replace the absorbent. Place to one side, for refitment in the lower position,

(b) the lower canister should be refitted in the upper position - see below.



Refitting the canisters

CAUTION

Efficient use of soda lime is only achieved if the newly refilled canister is replaced in the lower position.

1. Refit the canisters into the frame, with the newly filled canister in the lower position.

   Check that the seals and canisters align

2. Ensure that the top canister (3) engages correctly into the top seal (4) as you rotate the lever (2) clockwise to the vertical, locked-on position .

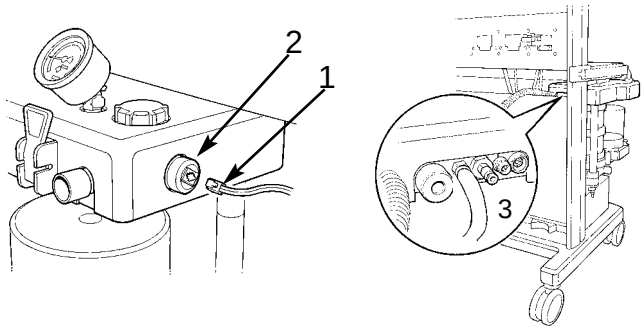
3. Leak test the absorber – see section 6.2 in the A100 User Manual.

Sterilisation

Caution

Do not autoclave:

Oxygen Sensor	*Manometer*
Top cover	*Bottom cover*

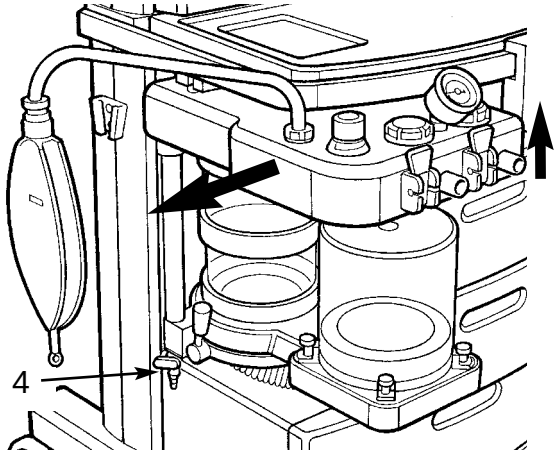


Absorber Assembly - removal before Sterilisation

WARNING
The absorber assembly weighs approximately 17 kg.
Take care when the absorber is removed from the machine.

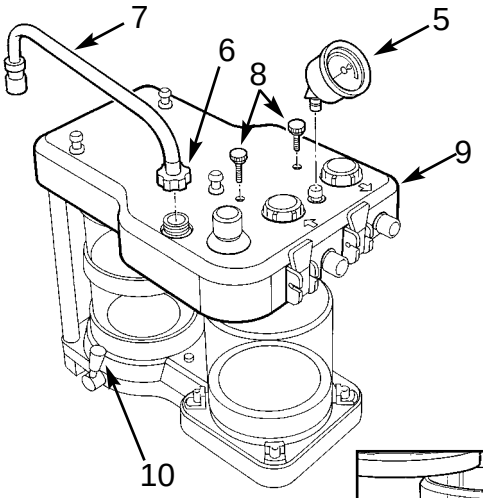
Remove

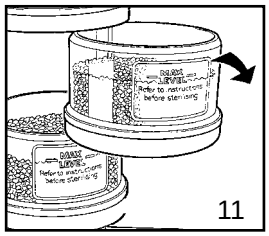
1. Disconnect the cable (1) from the O_2 sensor (2).
   Unscrew the sensor from the manifold block.
   Do not autoclave.
2. At the rear of the absorber manifold block, disconnect the hoses (apart from the fresh gas hose - 3) and cables.
   Disconnect the fresh gas hose from the CGO block on the anaesthetic machine.
3. Drain the condensate from the absorber.
   Refer to section 7.3.1 in the A100 User Manual.
   WARNING Condensation, which may collect in the bottom of the absorber is caustic and care must be taken not to spill it on the skin when draining the condensate trap.
   After draining ensure that the drain valve (4) is fully closed.
4. Apply the brake on the anaesthetic machine.
   Lift the right-hand side of the absorber and slowly slide the assembly out from the side of the machine.
   The absorber assembly weighs approximately 17 kg - support the absorber at the front and side as it is removed from the machine.

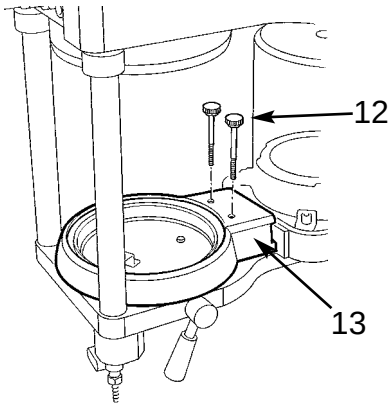


Remove the covers and canisters

5. Press the retaining clip and detach the manometer (5). Do not autoclave
6. Unscrew the retaining nut (6) and remove the bag arm (7).
7. Remove the screws (8) securing the top cover (9), and detach the cover from the absorber.
   Do not autoclave.
8. Turn the lever (10) at the base of the absorber anti-clockwise, and remove the top canister (11) sideways after disengaging the rubber seals by vertical movement.
   Remove the bottom canister.
   Dispose of the soda lime granules, and wash the canisters.
   Do not refit the canisters until the autoclave procedure is completed.
9. Remove the screws (12) securing the bottom cover (13), and detach the cover from the absorber.
   Do not autoclave.



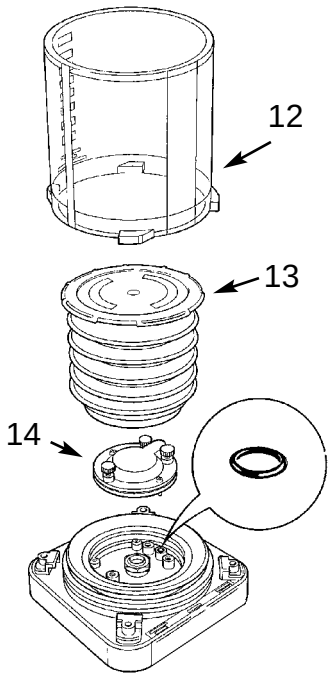




Bellows Assembly

10. Turn the bellows housing (12) anti-clockwise, then lift it from the base.
    Remove the bellows (13).

11 Undo the three retaining screws, then remove the exhalation valve assembly (14).



Cleaning procedures before sterilisation

Absorber :
Clean the frame and inspiratory and expiratory valve assemblies - refer to section 8.4 in the A100 User Manual.
The absorber assembly can then be autoclaved as a single unit.

Ventilator Bellows Assembly:
Refer to section 7.2 in the AV900 V4 user manual

Sterilisation and Autoclave

CAUTION
To prevent possible damage to components, peak sterilisation temperatures must not exceed :

54^{O}C (130^{O}F) for gas (ethylene oxide) or,

134^{O}C (275^{O}F) for steam autoclave.

Low temperature autoclave must not exceed 120^{O}C

Following sterilisation with ethylene oxide, components must be quarantined in a well ventilated area to allow dissipation of any residual gases.
Follow the recommendations given by the steriliser manufacturer for aeration periods required.

Sterilisation and Autoclave Treatment Table

ITEM	**METHOD**
A100SP Absorber assembly	Gas, liquid, autoclave
Absorber canisters	Liquid, **low temperature autoclave**
Ventilator bellows assembly components:	
Bellows	Gas, liquid, autoclave (20 cycles max.)
Hoses	Gas, liquid, autoclave
Bellows base	Gas, liquid, autoclave.
Bellows canister	Liquid, autoclave
Exhalation valve assembly	Gas, liquid, pasteurise, **low temperature autoclave**

NOTE
Examples of suitable liquid agents are: Nu-Cidex, Sporicidin, and Sonacide.

After Cleaning / Sterilisation

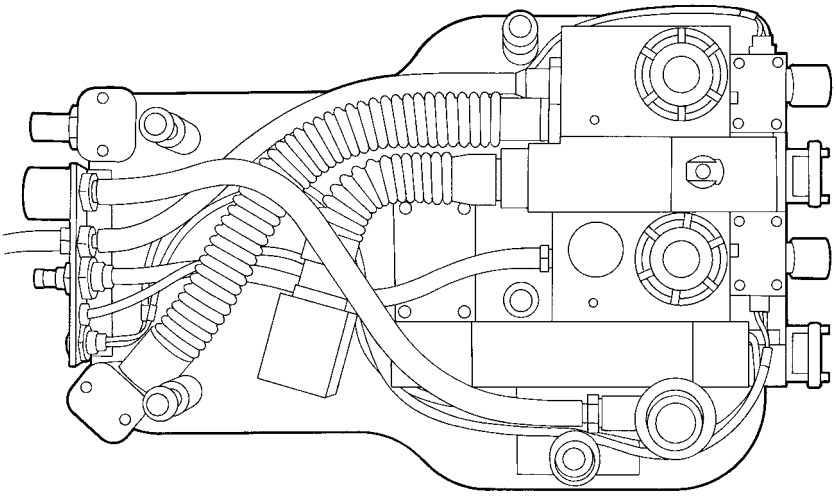
1. Check that all hoses and cables are secure and correctly routed.

2. Refit the covers.

3. Refit the canisters - see page 7 of this datasheet - Filling and Changing CO_2 Absorbent.

4. Refit the bag arm and bag.

5. Refit the Manometer.



Refitting the Absorber to the machine

WARNING
The absorber assembly weighs approximately 17 kg.
Take care when lifting the absorber and during installation.

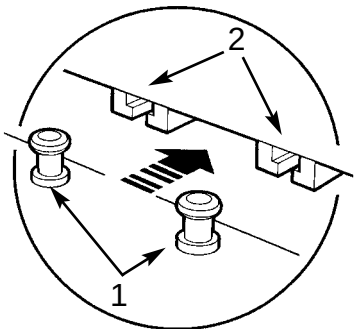
1. Apply the brake on the anaesthetic machine.

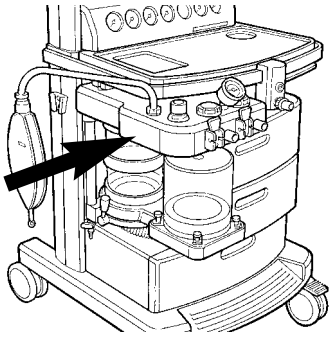
2. Align the mounting buttons (1) on the top of the absorber manifold block with the slots in the mounting plate (2) on the anaesthetic machine.

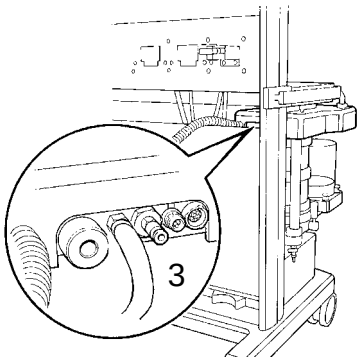
3. Slide the absorber into position.
   Continue to push the unit inwards until the right-hand side mounting buttons (1) drop into recesses in the mounting plate. This indicates that the assembly is correctly installed.
   Check that the assembly cannot be moved to the left.

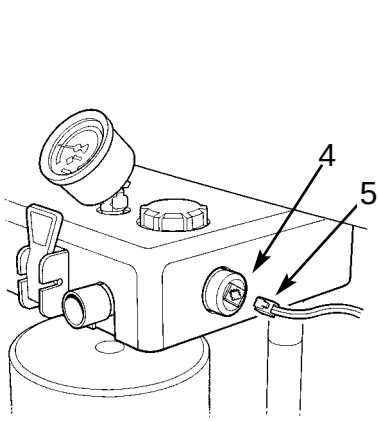
4. Reconnect the hoses and cables at the rear of the absorber manifold block (3).
   Check for correct fitment with the illustration on page 3 of this datasheet.

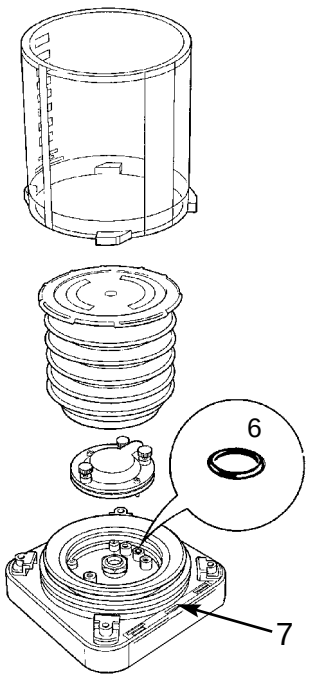
5. Refit the oxygen sensor (4) and reconnect the cable (5).











Ventilator Bellows Assembly

6. Reassemble the bellows components.
   Refer to sections 7.2 and 5.2 in the AV900 User Manual.
   Important - check that the O-rings (6 and 7) are in position.

Pre-use Checks

Carry out the Pre-use Checks listed in Section 6 of the A100 User Manual.

NOTE

A) The A100SP is not fitted with a PEEP valve.

B) Check the operation of the Bag/Vent switch detector - see section 3.5.14 in the AV900 V4 ventilator user manual.

Ordering Information

Retrofit Kits

To retrofit an A100SP absorber to an existing Prima SP (not applicable to Prima), order one of the following kits:

58113 A100SP (UK specification) retrofit kit - Prima SP102

58114 A100SP (US specification) retrofit kit - Prima SP102

58115 A100SP (UK specification) retrofit kit - Prima SP101

58116 A100SP (US specification) retrofit kit - Prima SP101

Each kit consists of an A100SP absorber, complete with AV-series bellows assembly, and mounts.

Accessories

Fresh gas hose	52590
Manometer	58112
Breathing circuit (black rubber)	58436
Absorber detachables	52582

Note:

1. Absorber detachables consists of:
   3 litre breathing bag
   1.05 m (42 inch) breathing tube
   Female mount
   Connector mount
   Facemask elbow
   Y piece

2. All standard connectors are for use with 30 mm taper anti-pollution systems.
   Models compatible with 19 mm systems are available on request.

InterMed Penlon

CE 0473

Cat. No. 52793
Doc. No. PR SP 0204SM
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